Red Hook Ballfields 5-8

Brooklyn, New York

QUALITY ASSURANCE PROJECT PLAN

Prepared for

NYC Parks

New York City Department of Parks and Recreation

Prepared by

TRC
Results you can rely on

TRC Engineers, Inc.

New York, New York

March 2016

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ATTACHMENTS

LIST OF ACRONYMS

ASP	Analytical Services Protocol
BGS	Below Ground Surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain of Custody
CVAA	Cold Vapor Atomic Absorption
DER	Division of Environmental Remediation
DQI	Data Quality Indicator
ECD	Electron Capture Detector
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Approval Program
EM	Electromagnetic
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
HASP	Health and Safety Plan
ICP	Inductively Coupled Plasma
IS	Internal Standard
LCS	Laboratory Control Sample
MDL	Method Detection Limit
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NIST	National Institute of Standards and Technology
NTUs	Nephelometric Turbidity Units
NYCDEP	New York City Department of Environmental Protection
NYCDOHMH	New York City Department of Health and Mental Hygiene
NYC DPR	New York City Department of Parks and Recreation
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
ORP	Oxidation-Reduction Potential
Oz	Ounce
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPM	Parts per Million
PQOs	Project Quality Objectives

LIST OF ACRONYMS

PVC	Polyvinyl Chloride
PT	Permeability Test
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
RPD	Relative Percent Difference
RRUSCOs	Restricted Residential Use Soil Cleanup Objectives
%RSD	Percent Relative Standard Deviation
SOPs	Standard Operating Procedures
SPT	Standard Penetration Testing
SVOC	Semivolatile Organic Compound
TSA	Technical System Audit
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

CROSSWALK

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QAPP Worksheet #1

TITLE AND APPROVAL PAGE

Quality Assurance Project Plan for Red Hook Ballfields 5 to 8, Brooklyn, New York
Document Title

New York City Department of Parks & Recreation
Lead Organization (Agency, State, Tribe, Federal Facility, PRP, or Grantee)

Jenna Raup, TRC Engineers, Inc.
Preparer's Name and Organizational Affiliation

1430 Broadway, 10th Floor, New York, NY 10018, (212) 221-7822
Preparer's Address and Telephone Number

February 22, 2016
Preparation Date (Day/Month/Year)

Investigative Organization's Program Manager: _____
Signature/Date

Jennifer Miranda/TRC Engineers, Inc.
Printed Name/Organization

Investigative Organization's Project Manager: _____
Signature/Date

Wes Lindemuth/TRC Engineers, Inc.
Printed Name/Organization

Investigative Organization's Project QA Officer: _____
Signature/Date

Elizabeth Denly/TRC Engineers, Inc.
Printed Name/Organization

Laboratory's Project Manager: _____
Signature/Date

Matt Cordova/Accutest Laboratories
Printed Name/Organization

Approval Signatures: _____
Signature/Date

Kay Zias/Director of Environmental Remediation
Printed Name/Title

NYC DPR
Approval Authority

QAPP Worksheet #2

QAPP IDENTIFYING INFORMATION

Site Name/Project Name: Red Hook Ballfields 5-8
Site Location: Brooklyn, New York
EPIN: 84614P0001002
Contractor Name: TRC Engineers, Inc.
Anticipated date of QAPP Implementation: February 2016

1. Identify guidance used to prepare QAPP:

Uniform Federal Policy for Quality Assurance Project Plans, Intergovernmental Data Quality Task Force, EPA-505-B-04-900A-C, March 2005

2. Identify regulatory program: **Order on Consent under CERCLA; Index No. CERCLA-02-2016-2010**

3. Identify approval entity: **New York City Department of Parks & Recreation and USEPA**

4. Indicate whether the QAPP is a generic program QAPP or a **project specific QAPP**.

5. List dates of scoping meetings that were held:
02/17/2016

6. List title of QAPP documents and approval dates written for previous site work, if applicable:

Title	Approval Date
Final Site-Specific UFP Quality Assurance Project Plan, Columbia Smelting and Refining Works Site, Brooklyn, Kings County, New York, Prepared by Removal Support Team 3, Weston Solutions, Inc., East Division	**February 2015**

7. List organizational partners (stakeholders) and connection with EPA and/or State:

NYCDOHMH, NYSDEC, USEPA, NYC DPR

8. List data users:

NYC DPR, USEPA

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable to the project, then underline the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below:

None

QAPP Worksheet #3

Distribution List

QAPP Recipients	Title	Organization	Telephone Number	Fax Number	E-Mail Address	Document Control Number
Kay Zias	Director of Environmental Remediation	NYC DPR	718-760-6748	--	Kay.Zias@parks.nyc.gov	NA
Imelda Bernstein	Project Manager / Landscape Architect	NYC DPR	718-760-6637	--	Imelda.Bernstein@parks.nyc.gov	NA
Marty Rowland	Senior Project Manager for Environmental Remediation	NYC DPR	347-865-3193	--	Marty.rowland@parks.nyc.gov	NA
Maureen Little	TBD	NYCDOHMH	646-632-6138	--	mlittle@health.nyc.gov	NA
Christopher D'Andrea	TBD	NYCDOHMH	646-632-6135	--	cdandrea@health.nyc.gov	NA
Margaret Gregor	On-Scene Coordinator	USEPA Region II	732-321-4424	--	Gregor.margaret@epa.gov	NA
Jane H. O'Connell	Chief, Superfund and Brownfield Cleanup Section, Division of Environmental Remediation	NYSDEC	718-482-4599	718-482-6358	Jane.oconnell@dec.ny.gov	NA
Jennifer Miranda	Program Manager	TRC	212-221-7822 x102	212-221-7840	jmiranda@trcsolutions.com	NA
Wes Lindemuth	Project Manager	TRC	212-221-7822 x149	212-221-7840	wlindemuth@trcsolutions.com	NA
Elizabeth Denly	Project QA Officer	TRC	978-656-3577	978-453-1995	edenly@trcsolutions.com	NA
Matt Cordova	Project Manager	Accutest Laboratories	732-355-4550	--	mattc@accutest.com	NA
James Malak	Project Manager / Engineer	OWEIS Engineering	973-539-4400	973-539-1122	jmalak@OweisEngineering.com	NA

NA – Not applicable

QAPP Worksheet #4

Project Personnel Sign-Off Sheet

Organization: TRC Engineers, Inc.

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
David S. Glass, P.E.	Principal	212-221-7822		
Jennifer Miranda	Program Manager	212-221-7822		
Wes Lindemuth, CHMM, CSP	Project Manager	212-221-7822		
Elizabeth Denly	Project QA Officer	978-656-3577		
Kirsten Myers, P.E.	Field Personnel	646-430-0582		
Patrick Narea, CPG	Field Team Manager	917-589-4907		

Organization: New York City Department of Parks & Recreation

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Kay Zias	Director of Environmental Remediation	718-760-6748		
Imelda Bernstein	Project Manager / Landscape Architect	718-760-6637		
Marty Rowland, PhD., P.E., CHMM	Senior Project Manager for Environmental Remediation	347-865-3193		

Organization: Accutest Laboratories

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Matt Cordova	Project Manager	732-355-4550		

Organization: OWEIS Engineering, Inc.

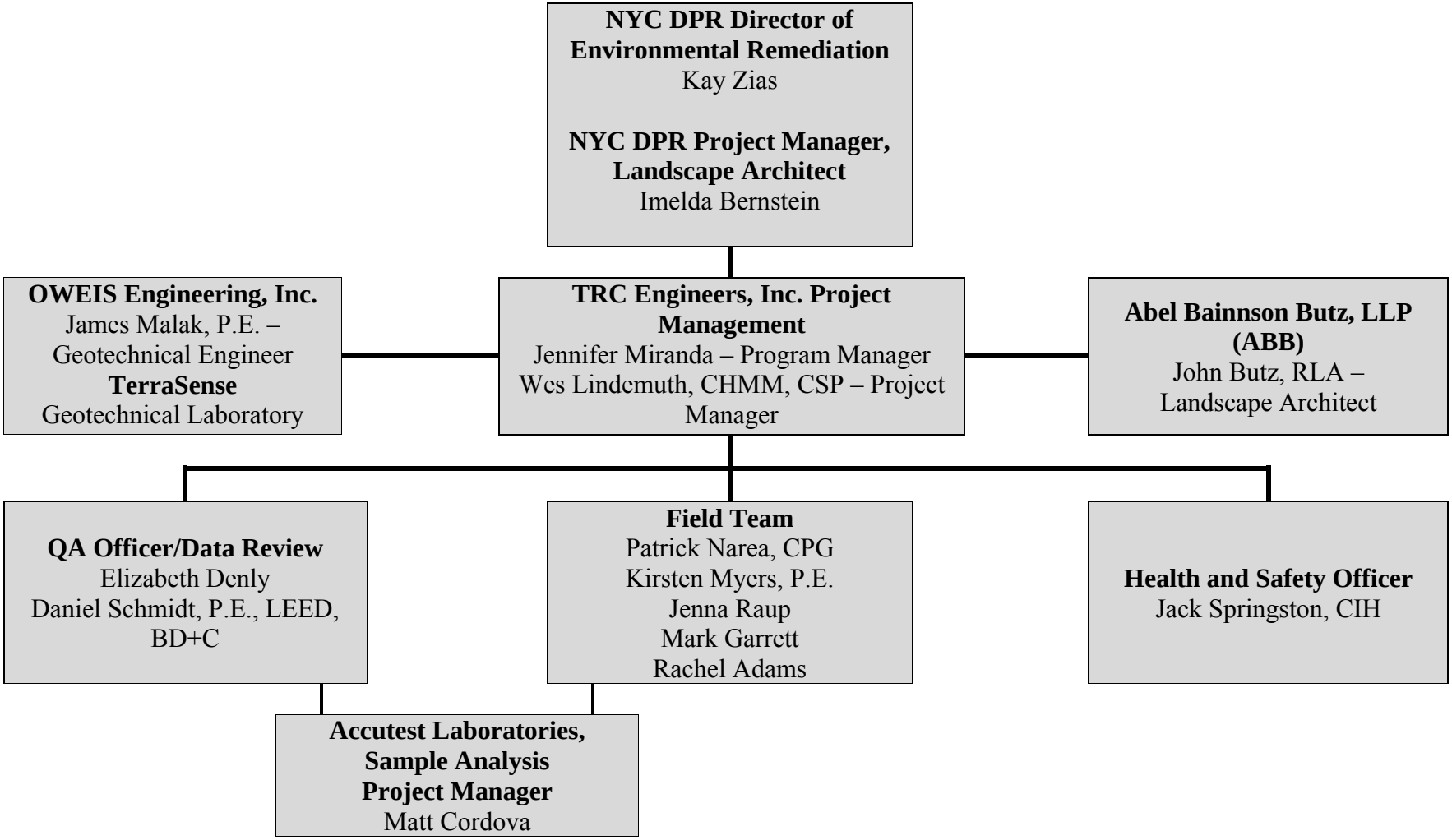
Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
James Malak	Project Manager / Engineer	973-539-4400		

Organization: TerraSense, LLC

Project Personnel	Title	Telephone Number	Signature	Date QAPP Read
Greg Thomas	Laboratory Director	973-812-8640		

QAPP Worksheet #5

Project Organization Chart



QAPP Worksheet #6

Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathways, etc.)
Primary point of contact with NYC DPR	TRC Program Manager	Jennifer Miranda	212-221-7822	All deliverables and information about the project will be forwarded to Kay Zias by Jennifer Miranda or Wes Lindemuth.
Manages all project phases	TRC Project Manager	Wes Lindemuth	212-221-7822	Wes Lindemuth will be secondary point of contact with Kay Zias and liaison between subcontractors, field staff and Jennifer Miranda.
QAPP modifications in the field	TRC Field Team Manager	Patrick Narea	917-589-4907	Notify Jenna Raup and/or Elizabeth Denly by phone of modifications to the QAPP made in the field and the reasons.
QAPP modifications in the field	OWEIS Field Team Manager	James Malak	973-539-4400	Wes Lindemuth will be the TRC point of contact to OWEIS who will notify Jenna Raup and/or Elizabeth Denly by phone of modifications to the QAPP made in the field and the reasons.
Health and Safety On-Site Meeting	TRC Field Team Manager	Patrick Narea	917-589-4907	Explain/review site hazards, personnel protective equipment, hospital location, etc.
	OWEIS Field Team Manager	James Malak	973-539-4400	

QAPP Worksheet #7

Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Kay Zias	Director of Environmental Remediation	NYC DPR	All project coordination, direction, and decision making	Not applicable
Imelda Bernstein	Project Manager / Landscape Architect	NYC DPR	All project coordination, direction, and decision making	Not applicable
Marty Rowland	Senior Project Manager for Environmental Remediation	NYC DPR	All project coordination, direction, and decision making	Not applicable
Jennifer Miranda	Program Manager	TRC	Oversees project and primary contact with NYC Parks	See Resume, Attachment 2
Wes Lindemuth	Project Manager	TRC	Manages project – coordinates field team and subcontractors	See Resume, Attachment 2
Elizabeth Denly	Project QA Officer	TRC	QA oversight and reviews QAPPs and analytical data	See Resume, Attachment 2
Patrick Narea	Field Team Manager/Site Safety Officer	TRC	Supervises field sampling and coordinates all field activities	See Resume, Attachment 2
Matt Cordova	Project Manager	Accutest Laboratories	Oversees project in analytical laboratory and main contact with TRC	On file at laboratory
James Malak	Project Manager / Engineer	OWEIS Engineering	Oversees geotechnical borings and sample collection and main contact with TRC.	On file at OWEIS

QAPP Worksheet #8

Special Personnel Training Requirements Table

Project Function	Specialized Training Title of Course or Description	Training Provided By	Training Date	Personnel/Groups Receiving Training	Personnel Titles/ Organizational Affiliation	Location of Training Records/Certificates
Field Activities	OSHA/HAZWOPER 40 hour training	Various trainers	Various	All staff to be used on-site	All	On file at TRC
Field Activities	OSHA/HAZWOPER 8 hour annual refresher training	Various trainers	Within last year, annually	All staff to be used on-site	All	On file at TRC
Field Activities	First Aid / CPR	Various trainers	Within last two years, biannually	All staff to be used on-site	All	On file at TRC

QAPP Worksheet #9

Project Scoping Session Participants Sheet

Project Name: Red Hook Ballfields 5-8 **Project Date(s) of Sampling:** March 7, 2016 – March 14, 2016 **Project Manager:** Wes Lindemuth	**Site Name:** Red Hook Ballfields 5-8 **Site Location:** Brooklyn, NY

Date of Session: February 17, 2016

Scoping Session Purpose: To discuss questions, comments, and assumptions regarding technical issues related to field work.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Kay Zias	Director of Environmental Remediation	NYC DPR	718-760-6748	Kay.Zias@parks.nyc.gov	All project coordination, direction, and decision making.
Imelda Bernstein	Project Manager / Landscape Architect	NYC DPR	718-760-6637	Imelda.Bernstein@parks.nyc.gov	Decisions relative to landscape architecture
Marty Rowland	Senior Project Manager for Environmental Remediation	NYC DPR	718-760-6922	Marty.Rowland@parks.nyc.gov	Project Manager for NYC DPR
Jennifer Miranda	Program Manager	TRC	212-221-7822	jmiranda@trcsolutions.com	Oversees project and primary contact with NYC DPR
Wes Lindemuth	Project Manager	TRC	212-221-7822	wlindemuth@trcsolutions.com	Manages project – coordinates field team and subcontractors

Comments/Decisions: The scope of work for Site investigation soil sampling includes the following:

- Five borings will be advanced across the Site at least one foot below the observed groundwater table for the purpose of infiltration testing and concurrent soil and groundwater sampling.
    - Up to three soil samples will be collected from each soil boring from the following intervals: 2-4 feet, 5-7 feet, and 8-10 feet.
    - Temporary well points will be installed in five (5) soil borings locations and groundwater samples will be collected for laboratory analyses as described below.
    - Soil and groundwater samples will be analyzed for 6 NYCRR Part 375-6.8(b)-listed parameters (including hexavalent chromium) and the following additional metals:

aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin.

- Advancement of 15 geotechnical borings to an approximate depth of 10 to 20 feet bgs and concurrent soil sampling.
    - Representative soil samples based on subsurface conditions will be collected via Standard Penetration Test Method in accordance with ASTM D1586 procedures.
    - Approximately 20 soil samples will be analyzed for grain size and/or atterberg limit determinations.

Action Items: Prepare HASP, Scope of Work and mobilize for field activities.

Consensus Decisions: Field activities will begin on or about March 7, 2016 and will be completed in approximately three weeks.

QAPP Worksheet #10

PROBLEM DEFINITION

The infiltration and geotechnical sampling to be conducted at the Site is tentatively scheduled to begin on March 7, 2016. The Site encompasses the Former Columbia Smelting and Refining Works Site (98 Lorraine Street) and was previously investigated under the direction of USEPA. The USEPA investigation soil samples were collected and analyzed for various metals. Soil samples exhibited metals at concentrations exceeding applicable regulatory limits. As a result of the investigation, and under the pending Order on Consent between USEPA and NYC DPR, a site-wide cap including consisting of clean soil cover and permeable synthetic turf is being designed and constructed under this phase of work. The infiltration and geotechnical investigations will be performed primarily to assess the conditions of the Site in advance of construction of a site-wide cap and assist the landscape architect in finalizing the design of the cap and drainage infrastructure options.

SITE HISTORY/CONDITIONS

The USEPA Removal Action Branch conducted a Removal Site Evaluation for the Columbia Smelting & Refining Works Site (the Site), a historic lead smelter facility which was referred to USEPA by NYSDEC.

The Site is located in the Red Hook neighborhood of Brooklyn, Kings County, New York in a mixed residential, commercial, and industrial area. The Site consists of Ballfields 5-8 encompassing approximately 4.17 acres within the Red Hook Recreation Area, a 58-acre park. The Site is designated as Block 581, Lot 1. The Order on Consent addresses Ballfields 5-8 and extends to the curb lines of the sidewalks surrounding the ball fields. The former Columbia Smelting & Refining Works facility was developed within Ballfield #7 (northwest corner of the Site).

The Site is bordered to the north by Lorraine Street followed by mid-rise residential buildings; to the east by Henry Street followed by the swimming pool and Recreation Center building (Red Hook Recreation Area); to the south by Bay Street followed by Soccer Field 3 and a running track (Red Hook Recreation Area); and to the west by a low-rise residential building and condemned former industrial plant.

According to the Weston "Final Site Specific QAPP", the Site was occupied by smelting and refining companies from the late 1920s through the late 1930s, including Delevan Smelting & Refining Co. in the late 1920s and Columbia Smelting & Refining Works from at least 1931 through the late 1930s. The Site was developed with a single-story, approximately 14,000-square foot building from the mid to late 1920s, which was razed prior to 1940. A 1931 advertisement in the Standard Metal Directory for Columbia Smelting & Refining Works, Inc. of 98 to 107 Lorraine Street indicated that the company dealt with white metals and alloys as well as brass and bronze ingots. The advertisement indicated that the company manufactured soft lead, antimonial lead, Babbitts, solder, type metals, terse metal, Britannia metal, die-cast metal, unbreakable metal, and rerun zinc; consumed pig percentage metal, cable lead, battery plates, soft lead, type metals, Babbitt, joists, pewter and dresses; and dealt in pig tin, pig lead, copper, antimony, aluminum, spelter, scrap metals and residues. A 1938 Sanborn map indicated that eight furnaces were present in the former on-site building, and that it was utilized as a refinery.

Since demolition of the historic Site building in the late 1930s, the Site has been utilized as a park and/or baseball diamond dating back to the early 1940s.

Soil sampling was conducted by the USEPA and the Weston Site Assessment Team. The NYC DPR

QAPP Worksheet #10

report entitled Red Hook Park Superfund Soil Sampling 2014-2015 Field Reports and Contaminant Results dated July 30, 2015 (Soil Sampling Report) was prepared to summarize the results of soil sampling conducted in October 2014, March 2015, and April 2015. The sampling events conducted in October 2014, March 2015, and April 2015 included soil sampling in the Columbia Smelting & Refining Works facility footprint; the Red Hook Houses; Ballfields 5-8, and 9; Soccer Fields 1, 2, and 6; west of Red Hook Pool, limited areas along Bay Street and one location in Soccer Field 3. The laboratory analytical results of the samples collected in the aforementioned areas, lead, antimony, tin, arsenic, and cadmium were detected above the Restricted Residential Use Soil Cleanup Objectives (RRUSCOs), and EPA Removal Management Levels (RMLs) in multiple sample intervals in the majority of the sample locations.

PROJECT DESCRIPTION

In order to assess subsurface soil and groundwater conditions at the Site in support of the design of the new synthetic turf Ballfields, the scope of work includes the following:

Infiltration Tests and Soil and Groundwater Sampling

- Five (5) borings will be advanced across the Site to at least one (1) foot below the observed groundwater table (estimated to be 8.5 to 10.5 feet bgs) for infiltration testing.
- The infiltration tests will be performed in accordance with the NYCDEP Office of Green Infrastructure procedures dated December 2015.
- Soil samples will be collected from the five (5) borings at up to three of the following intervals: 2-4, 5-7, and 8-10 feet bgs for a total of fifteen (15) soil samples (depending on how deep the water table is, assuring that the deepest sample collected is within one foot above the water table).
- A temporary well point will be installed at each boring. Five (5) groundwater samples, one from each temporary well point, will be collected.
- The fifteen (15) soil samples and five (5) groundwater samples will be analyzed for 6 NYCRR Part 375-6.8(b)-listed parameters (including hexavalent chromium) and the following additional metals: aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin. The following analytical methods will be used:

    - Part 375 VOCs: EPA Method 8260C
    - Part 375 SVOCs: EPA Method 8270D
    - Part 375 Pesticides: EPA Method 8081B
    - Part 375 Herbicide (Silvex): EPA Method 8151
    - TCL PCBs: EPA Method 8082A
    - TAL Metals+Tin: EPA Method 6010C (and 7470A/7471B for mercury and 7196A for hexavalent chromium)
    - Total Cyanide: EPA Method 9012B

    Quality Assurance and Quality Control sampling, including field blanks, site-specific matrix spike and matrix-spike duplicates (MS/MSD), equipment blanks and blind duplicate samples will be collected at a rate of one per 20 samples for soil (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate) and groundwater (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate). NYSDEC Analytical Services Protocol (ASP) Category B/Level 4 analytical data packages will be provided by the laboratory. TRC will perform 100% validation of the

QAPP Worksheet #10

data and prepare a Data Validation Report.

Geotechnical Sampling

- 15 borings will be advanced across the Site to approximately 10 to 20 feet bgs.
- Soil samples will be collected for geotechnical laboratory analysis including analysis of up to 20 samples for grain size and/or Atterberg limit determinations.
- QA/QC samples will not be collected and data validation will not be performed for the soil sampling associated with the geotechnical borings.

OBSERVATION FROM ANY SITE RECONNAISSANCE REPORT

None at this time.

PROJECT DECISION STATEMENTS

Soil analytical data will be compared to the NYSDEC RRUSCOs and USEPA RMLs. Groundwater analytical data will be compared to NYSDEC Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1, Ambient Water Quality Standards and Guidance Values. The results of the infiltration testing will provide data for the design of green infrastructure to dissipate increased stormwater runoff volumes that are anticipated for the fields that will be covered with synthetic turf. Additionally, the purpose of the infiltration testing and concurrent soil and groundwater sampling is to obtain background data that NYSDEC may request before approving the installation of green infrastructure that would allow water to infiltrate soil known to be contaminated with metal constituents.

Results of analysis of geotechnical soil samples will be used to determine adequate structural engineering components for the design of the Site cap.

QAPP Worksheet #11

Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?

The data will be used by USEPA, NYC DPR, TRC, Oweis and ABB.

What will the data be used for?

The analytical data will be used for the following:

1. Determine if green infrastructure consisting of subsurface infiltration structures will pose environmental risk by increasing contamination pathways to groundwater.
2. Determine appropriate structural measures for site-wide cap.

What type of data are needed? (target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)

Matrix	Type of Data	Analytical Technique	Parameters[1]	Equipment	Location
Soil – Grab	Definitive	Off-Site lab analyses	Note 1	Plastic scoops	One sample collected from each of three depth intervals in five (5) soil borings.
	Screened	Field Screening with photoionization detector (PID)	If maximum PID reading is ≤5 ppm above background concentrations, VOCs will not be analyzed by the laboratory	PID	
Groundwater - Grab	Definitive	Off-Site lab analyses	Note 1	Peristaltic pump, Horiba, dedicated tubing	One sample from each of five (5) temporary well points.
Soil – Grab	Definitive	Off-Site lab analyses	Grain Size and/or Atterberg Limit Determinations	Plastic scoops	Samples collected from 15 soil borings at discretion of geotechnical engineer based on subsurface conditions.

[1] 6 NYCRR Part 375-6.8(b)-listed parameters including the following metals: aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin.

How "good" do the data need to be in order to support the environmental decision?

Refer to Worksheets #12-1 through #12-18

QAPP Worksheet #11

Project Quality Objectives/Systematic Planning Process Statements

How much data are needed? (number of samples for each analytical group, matrix, and concentration)

Refer to Worksheet #20

Where, when, and how should the data be collected/generated?

Samples shall be collected from sampling locations shown on Attachment 1 – Site Plan. Samples will be collected in accordance with the SOPs identified on Worksheets #21 & #23. Sampling is scheduled to begin on or after February 29, 2016.

Who will collect and generate the data?

Refer to Worksheets #21 and #23

How will the data be reported?

A summary report with a discussion of field activities, results of analyses, and findings and conclusions will be prepared and submitted to NYC DPR.

How will the data be archived?

TBD

QAPP Worksheet #12-1

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	VOCs
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-01	Precision – Laboratory[2]	RPDs as follows: 1,1-dichloroethene: 17 trichloroethene: 14 benzene: 12 toluene: 13 chlorobenzene: 12	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 1,1-dichloroethene: 40-137 trichloroethene: 55-136 benzene: 43-138 toluene: 51-136 chlorobenzene: 70-124	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 1,1-dichloroethene: 73-127 trichloroethene: 83-122 benzene: 81-119 toluene: 80-122 chlorobenzene: 84-116	Laboratory Control Sample	A
	Accuracy/Bias[2]	Percent recoveries as follows: dibromofluoromethane: 76-120 1,2-dichloroethane-d_4: 73-122 toluene- d_8: 84-119 4-bromofluorobenzene: 78-117	Surrogates	A
	Accuracy/Bias – Contamination	Method Blank – No target compounds $\geq$ QL (exceptions for methylene chloride, acetone and 2-butanone < 2x QL)	Method Blanks	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis. All target VOCs will be evaluated; criteria for select VOCs representing the entire list are presented in this worksheet.

QAPP Worksheet #12-2

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	SVOCs
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-02	Precision – Laboratory[2]	RPDs as follows: phenol: 22 2-methylphenol: 18 benzo(a)pyrene: 25 chrysene: 24 acenaphthene: 23 fluoranthene: 24 hexachorobenzene: 24 pentachlorophenol: 25 pyrene: 26	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: phenol: 22-100 2-methylphenol: 47-112 benzo(a)pyrene: 41-127 chrysene: 41-128 acenaphthene: 52-120 fluoranthene: 47-123 hexachorobenzene: 46-125 pentachlorophenol: 25-151 pyrene: 43-124	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 2-fluorophenol: 14-88 phenol- d_5: 10-110 nitrobenzene-d_5: 32-128 2-fluorobiphenyl: 35-119 2,4,6-tribromophenol: 39-149 terphenyl-d_{14}: 10-126	Surrogates	A
	Accuracy/Bias[2]	Percent recoveries as follows: phenol: 10-110 2-methylphenol: 42-103 benzo(a)pyrene: 41-127 chrysene: 45-125 acenaphthene: 54-112 fluoranthene: 58-116 hexachorobenzene: 49-122 pentachlorophenol: 30-136 pyrene: 47-120	Laboratory Control Sample	A

QAPP Worksheet #12-2

Measurement Performance Criteria Table

Matrix	Groundwater				
Analytical Group	SVOCs				
Concentration Level	Low				
Analytical Method/SOP[1]		**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
		Accuracy/Bias – Contamination	Method Blank – No target compound ≥ QL (except phthalates must be ≤5x QL)	Method Blanks	A
		Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis. All target SVOCs will be evaluated; criteria for select SVOCs representing the entire list are presented in this worksheet.

QAPP Worksheet #12-3

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Metals (Filtered and Unfiltered)
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-03	Precision – Laboratory	If results are $\geq$ 5 x QL, RPD < 20. If results are < 5x QL, difference between results < QL.	Laboratory Duplicates	A
	Accuracy/Bias	Percent recoveries 75 – 125%	Laboratory Matrix Spikes	A
	Accuracy/Bias	Percent recoveries 80 – 120%	Laboratory Control Sample	A
	Accuracy/Bias	$\pm$ 10% of original result	Serial Dilution Analysis	A
	Accuracy/Bias	Percent recoveries 70-130% (50-150% for Co, Mn, Zn)	Detection Limit Standard	A
	Accuracy/Bias	Percent recoveries 80 – 120%	Interference Check Sample	A
	Accuracy/Bias – Contamination	Absolute value of target metal $\leq$ QL	Initial Calibration Blanks, Continuing Calibration Blanks, and Preparation Blanks	A
	Data Completeness	Field 90%, Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-4

Measurement Performance Criteria Table

Matrix	Groundwater				
Analytical Group	Mercury (Filtered and Unfiltered)				
Concentration Level	Low				
Analytical Method/SOP[1]		**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
L-04		Precision – Laboratory	RPD ≤ 20 if results are ≥ 5x QL	Laboratory Duplicates	A
		Accuracy/Bias	Percent recoveries 75-125%	Laboratory Matrix Spikes	A
		Precision-Laboratory	RPD ≤ 20%	Laboratory Matrix Spikes/Matrix Spike Duplicates	A
		Accuracy/Bias	Percent recovery 80-120%	Laboratory Control Sample	A
		Accuracy/Bias – Contamination	No target compounds ≥ QL	Initial Calibration Blanks, Continuing Calibration Blanks, and Preparation Blanks.	A
		Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-5

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Hexavalent Chromium (Filtered and Unfiltered)
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-05	Precision – Laboratory	RPD $\leq$ 20	Laboratory Duplicate	A
	Accuracy/Bias	85-115%	Laboratory Matrix Spike	A
	Accuracy/Bias	Percent recoveries 90-110%	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target analytes > QL	Method Blanks, Calibration Blanks	A
	Accuracy/Bias	Percent recoveries 85-115%	Post Digestion Spike	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-6

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Cyanide
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-06	Precision – Laboratory	RPD $\leq$ 20 if results are $\geq$ 5x QL	Laboratory Duplicates	A
	Accuracy/Bias	Percent recovery 90-110%	Laboratory Matrix Spikes	A
	Accuracy/Bias	Percent recovery 90-110%	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ QL	Initial Calibration Blanks, Continuing Calibration Blanks, and Preparation Blanks.	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-7

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	Pesticides
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-07	Precision – Laboratory[2]	RPDs as follows: gamma-BHC: 37 Heptachlor: 37 Aldrin: 40 Dieldrin: 36 Endrin: 35 4,4'-DDT: 33	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: gamma-BHC: 44-160 Heptachlor: 33-153 Aldrin: 37-159 Dieldrin: 42-161 Endrin: 44-166 4,4'-DDT: 41-173	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	No target analytes ≥ MDL	Instrument Blanks	A
	Accuracy/Bias	Percent breakdown of DDT and Endrin must be ≤ 15	Endrin/DDT Breakdown Standard	A
	Accuracy/Bias[2]	Percent recoveries as follows: tetrachloro-m-xylene: 26-132 decachlorobiphenyl: 10-118	Surrogates	A
	Accuracy/Bias[2]	Percent recoveries as follows: gamma-BHC: 53-142 Heptachlor: 45-137 Aldrin: 38-138 Dieldrin: 54-144 Endrin: 53-149 4,4'-DDT: 53-158	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds ≥ QL	Method Blanks	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis. All target pesticides will be evaluated; criteria for select pesticides representing the entire list are presented in this worksheet.

QAPP Worksheet #12-8

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	2,4,5-TP (Silvex)
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-08	Precision – Laboratory	RPDs as follows: 2,4,5-TP (Silvex): 29	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	Percent recoveries as follows: 2,4,5-TP (Silvex): 28-152	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	No target analytes $\geq$ MDL	Instrument Blanks	A
	Accuracy/Bias	Percent recoveries as follows: 2,4-DCAA: 39-159	Surrogates	A
	Accuracy/Bias	Percent recoveries as follows: 2,4,5-TP (Silvex): 44-144	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ QL	Method Blanks	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-9

Measurement Performance Criteria Table

Matrix	Groundwater
Analytical Group	PCB Aroclors
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-09	Precision – Laboratory[2]	RPDs as follows: Aroclor 1016: 39 Aroclor 1260: 40	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: Aroclor 1016: 39-176 Aroclor 1260: 15-174	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	No target analytes ≥ QL	Instrument Blanks	A
	Accuracy/Bias[2]	Percent recoveries as follows: tetrachloro-m-xylene: 10-161 decachlorobiphenyl: 10-137	Surrogates	A
	Accuracy/Bias[2]	Percent recoveries as follows: Aroclor 1016: 50-159 Aroclor 1260: 42-155	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds ≥ QL	Method Blanks	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis.

QAPP Worksheet #12-10

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	VOCs
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-01	Precision – Laboratory[2]	RPDs as follows: 1,1-dichloroethene: 30 benzene: 30 chlorobenzene: 29 toluene: 30 trichloroethene: 29	Laboratory Matrix Spike/ Matrix Duplicate	A
	Accuracy/Bias[2]	Percent recoveries as follows: 1,1-dichloroethene: 41-143 benzene: 48-136 chlorobenzene:38-144 toluene: 40-141 trichloroethene: 42-152	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 1,1-dichloroethene: 71-128 benzene: 77-122 chlorobenzene: 79-120 toluene: 75-123 trichloroethene: 79-127	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ QL (except methylene chloride, acetone and 2-butanone < 2x QL)	Method Blanks	S & A
	Accuracy/Bias[2]	Percent recoveries as follows: 1,2-dichloroethane-d_4: 68-124 dibromofluoromethane: 70-122 toluene-d_8: 77-125 bromofluorobenzene: 72-130	Surrogates	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis. All target VOCs will be evaluated; criteria for select VOCs representing the entire list are presented in this worksheet.

QAPP Worksheet #12-11

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	SVOCs
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-02	Precision – Laboratory[2]	RPDs as follows: 2-methylphenol: 34 benzo(a)pyrene: 42 chrysene: 43 acenaphthene: 36 fluoranthene: 46 hexachorobenzene: 34 pentachlorophenol: 43 phenol: 33 pyrene: 46	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 2-methylphenol: 32-111 benzo(a)pyrene: 22-144 chrysene: 21-142 acenaphthene: 34-125 fluoranthene: 15-143 hexachorobenzene: 34-125 pentachlorophenol: 10-131 phenol: 25-112 pyrene: 16-147	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 2,4,6-tribromophenol: 24-140 2-fluorobiphenyl: 36-112 2-fluorophenol: 30-106 nitrobenzene d_5: 26-122 phenol-d_5: 30-106 terphenyl-d_{14}: 36-132	Surrogates	A

QAPP Worksheet #12-11

Measurement Performance Criteria Table

Matrix	Soil				
Analytical Group	SVOCs				
Concentration Level	Low				
Analytical Method/SOP[1]		**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
		Accuracy/Bias[2]	Percent recoveries as follows: 2-methylphenol: 53-103 benzo(a)pyrene: 56-122 chrysene: 51-119 acenaphthene: 60-108 fluoranthene: 58-110 hexachorobenzene: 55-114 pentachlorophenol: 29-128 phenol: 45-106 pyrene: 50-117	Laboratory Control Sample	A
		Accuracy/Bias – Contamination	No target compounds $\geq$ QL (except phthalates must be $\leq$ 5 x QL)	Method Blanks	S & A
		Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis. All target SVOCs will be evaluated; criteria for select SVOCs representing the entire list are presented in this worksheet.

QAPP Worksheet #12-12

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Metals
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-03	Precision – Laboratory	RPD $\leq$ 20 if results are $\geq$ 5x QL	Laboratory Duplicates	A
	Accuracy/Bias	Percent recoveries 75 – 125%	Laboratory Matrix Spikes	A
	Accuracy/Bias	Percent recoveries 80-120%	Laboratory Control Sample	A
	Accuracy/Bias	$\pm$ 10% of original result	Serial Dilution Analysis	A
	Accuracy/Bias	Percent recoveries 70 – 130% (50-150% for Co, Mn, Zn)	Detection Limit Standard	A
	Accuracy/Bias	Percent recoveries 80 – 120%	Interference Check Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ ½ QL	Initial Calibration Blanks, Continuing Calibration Blanks, and Preparation Blanks	S & A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-13

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Mercury
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-10	Precision – Laboratory	RPD ≤ 24 if results are ≥ 5x QL	Laboratory Duplicates	A
	Accuracy/Bias	Percent recoveries 75 – 125%	Laboratory Matrix Spikes	A
	Accuracy/Bias	RPD ≤ 20	Laboratory Matrix Spike Duplicate	A
	Accuracy/Bias	Percent recovery 85-115%	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds ≥ QL	Initial Calibration Blanks, Continuing Calibration Blanks, and Preparation Blanks.	S & A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-14

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Hexavalent Chromium
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-11	Precision – Laboratory	RPD $\leq$ 20	Laboratory Duplicate	A
	Accuracy/Bias	Percent recoveries 75-125%	Laboratory Matrix Spike	A
	Accuracy/Bias	Percent recoveries 80-120%	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target analytes > QL	Method Blanks and Calibration Blanks	S & A
	Accuracy/Bias	Percent recoveries 85-115%	Post Digestion Spike	A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-15

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Cyanide
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-06	Precision – Laboratory	RPD $\leq$ 20 if results are $\geq$ 5x QL	Laboratory Duplicates	A
	Accuracy/Bias	Percent recoveries 75 – 125%	Laboratory Matrix Spikes	A
	Accuracy/Bias	Percent recovery 90-110%	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ QL	Initial Calibration Blanks, Continuing Calibration Blanks and Preparation Blanks.	S & A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-16

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	Pesticides
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-07	Precision – Laboratory[2]	RPDs as follows: aldrin: 48 dieldrin: 54 endrin: 53 gamma-BHC: 47 * heptachlor: 49 4,4'-DDT: 49	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias[2]	Percent recoveries as follows: aldrin: 19-147 dieldrin: 10-157 endrin: 14-154 gamma-BHC: 16-143 heptachlor: 10-159 4,4'-DDT: 10-187	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	No target analytes $\geq$ QL	Instrument Blanks	A
	Accuracy/Bias	Percent breakdown of DDT and Endrin must be < 15 for each compound	Endrin/DDT Breakdown Standard	A
	Accuracy/Bias[2]	Percent recoveries as follows: tetrachloro-m-xylene: 24-136 decachlorobiphenyl: 10-153	Surrogates	A
	Accuracy/Bias[2]	Percent recoveries as follows: aldrin: 40-135 dieldrin: 33-133 endrin: 41-134 gamma-BHC: 36-128 heptachlor: 36-132 4,4'-DDT: 26-150	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ QL	Method Blanks	S & A

QAPP Worksheet #12-16

Measurement Performance Criteria Table

Matrix	Soil				
Analytical Group	Pesticides				
Concentration Level	Low				
Analytical Method/SOP[1]		**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
		Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis. All target pesticides will be evaluated; criteria for select pesticides representing the entire list are presented in this worksheet.

QAPP Worksheet #12-17

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	2,4,5-TP (Silvex)
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-08	Precision – Laboratory	RPDs as follows: 2,4,5-TP (Silvex): 52	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	Percent recoveries as follows: 2,4,5-TP (Silvex): 10-146	Laboratory Matrix Spike/ Matrix Spike Duplicates	A
	Accuracy/Bias	No target analytes $\geq$ QL	Instrument Blanks	A
	Accuracy/Bias	Percent recoveries as follows: 2,4-DCAA: 10-156	Surrogates	A
	Accuracy/Bias[2]	Percent recoveries as follows: 2,4,5-TP (Silvex): 53-132	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds $\geq$ QL	Method Blanks	S & A
	Data Completeness	Field 90%, Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.

QAPP Worksheet #12-18

Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	PCB Aroclors
Concentration Level	Low

Analytical Method/SOP[1]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
L-09	Precision – Laboratory[2]	RPDs as follows: Aroclor 1016: 47 Aroclor 1260: 49	Laboratory Matrix Spike/ Matrix Spike Duplicates[3]	A
	Accuracy/Bias[2]	Percent recoveries as follows: Aroclor 1016: 32-176 Aroclor 1260: 19-180	Laboratory Matrix Spike/ Matrix Spike Duplicates[3]	A
	Accuracy/Bias	No target analytes ≥ QL	Instrument Blanks	A
	Accuracy/Bias[2]	Percent recoveries as follows: tetrachloro-m-xylene: 20-152 decachlorobiphenyl: 12-157	Surrogates	A
	Accuracy/Bias[2]	Percent recoveries as follows: Aroclor 1016: 48-167 Aroclor 1260: 44-162	Laboratory Control Sample	A
	Accuracy/Bias – Contamination	No target compounds ≥ QL	Method Blanks	S & A
	Data Completeness	Laboratory 95%	Data Completeness Check	S & A

[1] Reference number from QAPP Worksheet #23.
[2] Laboratory control limits are periodically updated. The latest control limits will be utilized at the time of sample analysis.

QAPP Worksheet #13

Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Generation/Collection Dates)	How Data May Be Used (if deemed usable during data assessment stage)	Limitations on Data Use
Surface Soil Sampling	Weston Solutions, Inc., "Sampling Trip Report, Task No. 1211, Columbia Smelting & Refining Works", October 27, 2014	Between October 2014 and April 2015, USEPA Site Assessment Team and Removal Assessment Team 3 (Weston Solutions) collected the following: 82 discrete samples from 16 locations in October 2014; 153 samples from 29 locations, including 94 five-point composites from 18 quadrants in March 2015; and in April 2015, 225 five-point composite samples from 43 quadrants, all of which were analyzed for TAL metals + tin.	Based on the concentrations of metals (specifically lead), the Site will be capped. The cap will consist of permeable synthetic turf.	This data was used to determine that a removal action is required as per the Order on Consent.
Surface Soil Sampling	Weston Solutions, Inc., "Final P Soil Sampling Trip Report – Columbia Smelting & Refining Works Site", April 9, 2015			
Surface Soil Sampling	Weston Solutions, Inc., "Final Phase II Soil Sampling Trip Report – Columbia Smelting & Refining Works Site", June 19, 2015			
Surface Soil Sampling	Red Hook Park Superfund Soil Sampling 2014-2015 Field Reports and Contaminant Results dated July 30, 2015 (Soil Sampling Report)	This report summarizes the results of sampling by Weston Solutions, Inc., which are reported in the above Trip Reports. This report does not include any additional sampling results.	NA	NA

QAPP Worksheet #14

Summary of Project Tasks

Sampling Tasks:

The scope of sampling includes the following:

- Infiltration testing will be performed at five (5) boring locations across the Site in accordance with the NYCDEP Office of Green Infrastructure procedures. At each of these borings, based on the depth to groundwater, soil samples will be collected from up to three of the following intervals: 2-4, 5-7, and 8-10 feet bgs. Soil samples collected from infiltration borings will be analyzed for Part 375 SVOCs, TAL metals, cyanide, Part 375 pesticides, the Part 375 herbicide Silvex, and TCL PCBs. Soils will be screened with a PID for presence of VOCs. If PID readings are >5 ppm above background concentrations, a sample will be collected for analysis of VOCs.
- Groundwater samples will be collected at the five (5) borings used for infiltration testing and will be analyzed for the same parameters listed above including filtered and unfiltered metals.
- Geotechnical soil sampling will be conducted at 15 soil boring locations across the Site and up to 20 samples will be analyzed for grain size and/or Atterberg limit determinations.
- Following sample collection, a site-wide land survey will be performed. The ground surface elevation and global positioning system coordinates of each temporary groundwater monitoring well will be documented. The groundwater table surface will be referenced in feel below ground surface (bgs) and elevation in North American Vertical Datum of 1988 (NAVD 88).

Analysis Tasks:

Soil and Groundwater

- Part 375 VOCs: EPA Method 8260C (if required)
- Part 375 SVOCs: EPA Method 8270D
- Part 375 Pesticides: EPA Method 8081B
- Part 375 Herbicide - Silvex: EPA Method 8151
- TCL PCBs: EPA Method 8082A
- TAL Metals: EPA Method 6010C (and 7470A/7471B for mercury and 7196A for hexavalent chromium)
- Total Cyanide: EPA Method 9012B

Geotechnical Soil Samples

- Grain size – ASTM D422
- Atterberg Limit Determinations – ASTM D4318

Quality Control Tasks:

No field QC samples will be collected as part of infiltration or geotechnical sampling.

Secondary Data:
Not applicable

Data Management Tasks:

Activities under this project will be reported in daily progress emails, trip reports, and other deliverables (e.g., maps/figures, analytical reports, and data submittals). Activities will also be summarized in appropriate format for inclusion in monthly and annual reports.

TRC will setup a project-specific SharePoint web site on TRC's network for file sharing and to control and track documents, correspondence and submittals for the project. This system will serve to enable TRC to make any files, documents or records readily available to NYC DPR upon request.

The following deliverables may be provided under this project:

Daily Progress Emails:

Daily progress emails will be prepared that document the field activities conducted when executing field assignments. Any deviations from the QAPP will be discussed in the daily progress emails.

Trip Report:

A trip report will be prepared to provide a detailed accounting of activities during the sampling event. A trip report will be prepared within eight weeks of the last day of the sampling event. Information will be provided on time of major events, dates, and on-site personnel including affiliations.

Maps/Figures:

Maps depicting Site layout and sample locations will be included in the trip report, as appropriate.

Analytical Report:

An analytical report will be prepared for samples analyzed under this plan. The analytical report will be provided two weeks after receiving final data. Information regarding the analytical methods or procedures employed, sample results, QA/QC results, chain-of-custody (COC) documentation, laboratory correspondence, and raw data will be provided within this deliverable.

Data Review:

A review of the data generated under this plan will be conducted. The assessment of data acceptability or usability will be provided as part of the final report.

Documentation and Records:

All sample documents will be completed legibly, in ink. Any corrections or revisions will be made by lining through the incorrect entry and by initialing the error.

Field Logbook:

The field logbook is a descriptive notebook recording site activities and observations so that an accurate account of field procedures can be reconstructed in the writer's absence. The field logbooks will be bound and paginated. Entries will be dated and signed by the individuals making the entries, and should include (at a minimum) the following:

1. Site name and project number
2. Name(s) of personnel on-site
3. Dates and times of entries (military time preferred)
4. Descriptions of site activities, site entry and exit times
5. Noteworthy events and discussions
6. Weather conditions
7. Site observations
8. Sample and sample location identification and description*
9. Subcontractor information and names of on-site personnel
10. Date and time of sample collections, along with COC information
11. Record of photographs
12. Site sketches

*The description of each sample location will be in such a manner as to allow the reader to reproduce the location in the field at a later date.

Sample Labels: Sample labels will clearly identify the particular sample, and should include the following:

1. Site/project number.
2. Sample identification number.
3. Sample collection date and time.
4. Designation of sample (grab or composite).
5. Sample preservation.
6. Analytical parameters.
7. Name of sampler.

Sample labels will be written in indelible ink and securely affixed to the sample container. Tie-on labels can be used if properly secured.

Chain-of-Custody: The chain-of-custody (COC) will be fully completed including laboratory codes in lieu of analytical methods noted above as follows:

Analysis	Laboratory Test Code
Part 375 VOCs: EPA Method 8260C (if required)	V8260SCO
Part 375 SVOCs: EPA Method 8270D	AB8270SCO
Part 375 Pesticides: EPA Method 8081B	P8081SCO
Part 375 Herbicide - Silvex: EPA Method 8151	H8151245TP
TCL PCBs: EPA Method 8082A	P8082PCB
TAL Metals: EPA Method 6010C (7470A/7471B for mercury)	MTAL + SN
Total Cyanide: EPA Method 9012B	CN
Chromium, Trivalent	CR3
Chromium, Hexavalent: EPA Method 7196A	XCRA

An example COC is provided in Attachment 4.

Custody Seals:

Custody seals demonstrate that a sample container has not been tampered with or opened. The individual in possession of the sample(s) will sign and date the seal, affixing it in such a manner that the container cannot be opened without breaking the seal. The name of this individual, along with a description of the sample packaging, will be noted in the field logbook.

Data Packages:

NYSDEC Analytical Services Protocol (ASP) Category B/Level 4 analytical data packages will be provided by the laboratory. The laboratory will also provide Electronic Data Deliverables (EDDs) in the NYSDEC EQuIS format.

Assessment/Audit Tasks:

One field audit may be scheduled for this investigation.

Data Verification and Validation Tasks:

No data collected as part of infiltration testing of soil and groundwater or geotechnical sampling of soil will undergo validation.

Data Usability Assessment Tasks:

A data usability assessment will be conducted as per Worksheet #37.

QAPP Worksheet #15-1

Matrix: *Groundwater*
Analytical Group: *Volatiles*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
1,1,1-Trichloroethane	71-55-6	5	1	0.25	1
1,1-Dichloroethane	75-34-3	5	1	0.17	1
1,1-Dichloroethene	75-35-4	5	1	0.51	1
1,2,4-Trimethylbenzene	120-82-1	5	2	0.22	2
1,2-Dichlorobenzene	95-50-1	3	1	0.19	1
1,2-Dichloroethane	107-06-2	0.6	1	0.18	1
1,3,5-Trimethylbenzene	108-67-8	5	2	0.29	2
1,3-Dichlorobenzene	541-73-1	3	1	0.23	1
1,4-Dichlorobenzene	106-46-7	3	1	0.27	1
1,4-Dioxane	123-91-1	NS	130	41	130
2-Butanone (MEK)	78-93-3	50	10	5.6	10
Acetone	67-64-1	50	10	3.3	10
Benzene	71-43-2	1	0.5	0.24	0.5
Carbon tetrachloride	56-23-5	5	1	0.22	1
Chlorobenzene	108-90-7	5	1	0.19	1
Chloroform	67-66-3	7	1	0.19	1
cis-1,2-Dichloroethene	156-59-2	5	1	0.27	1
Ethylbenzene	100-41-4	5	1	0.27	1
m,p-Xylene	108-38-3 / 106-42-3	5	1	0.38	1
Methyl tert-butyl ether	1634-04-4	10	1	0.24	1
Methylene chloride	75-09-2	5	2	0.73	2
n-Butylbenzene	104-51-8	5	2	0.14	2
n-Propylbenzene	103-65-1	5	2	0.21	2
o-Xylene	95-47-6	5	1	0.17	1
sec-Butylbenzene	135-98-8	5	2	0.21	2
tert-Butylbenzene	98-06-6	5	2	0.28	2
Tetrachloroethene	127-18-4	5	1	0.4	1
Toluene	108-88-3	5	1	0.16	1
trans-1,2-Dichloroethene	156-60-5	5	1	0.65	1
Trichloroethene	79-01-6	5	1	0.22	1
Vinyl chloride	75-01-4	2	1	0.15	1
Xylenes (total)	1330-20-7	NS	1	0.17	1

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
* MDLs are updated annually and will be evaluated at the time of sample analysis.
NS – None specified
Gray shaded cells indicate project action limit will not be achieved.

QAPP Worksheet #15-2

Matrix: *Groundwater*
Analytical Group: *Semivolatiles*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
2-Methylphenol	95-48-7	1**	2	0.82	2
3&4-Methylphenol	108-39-4 / 106-44-5	1**	2	0.67	2
Acenaphthene	83-32-9	20	1	0.29	1
Acenaphthylene	208-96-8	NS	1	0.24	1
Anthracene	120-12-7	50	1	0.25	1
Benzo(a)anthracene	56-55-3	0.002	1	0.32	1
Benzo(a)pyrene	50-32-8	0.33	1	0.33	1
Benzo(b)fluoranthene	205-99-2	0.002	1	0.32	1
Benzo(g,h,i)perylene	191-24-2	NS	1	0.41	1
Benzo(k)fluoranthene	207-08-9	0.002	1	0.37	1
Chrysene	218-01-9	0.002	1	0.35	1
Dibenzo(a,h)anthracene	53-70-3	NS	1	0.37	1
Dibenzofuran	132-64-9	NS	5	0.27	5
Fluoranthene	206-44-0	50	1	0.23	1
Fluorene	86-73-7	50	1	0.29	1
Hexachlorobenzene	118-74-1	0.04	1	0.42	1
Indeno(1,2,3-cd)pyrene	193-39-5	0.002	1	0.38	1
Naphthalene	91-20-3	10	1	0.28	1
Pentachlorophenol	87-86-5	1**	5	1.4	5
Phenanthrene	85-01-8	50	1	0.23	1
Phenol	108-95-2	1**	2	0.31	2
Pyrene	129-00-0	50	1	0.34	1

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
* MDLs are updated annually and will be evaluated at the time of sample analysis.
**Applies to the sum of phenolic compounds.
NS – None specified
Gray shaded cells indicate project action limit will not be achieved.

QAPP Worksheet #15-3

Matrix: *Groundwater*
Analytical Group: *Metals (Filtered and Unfiltered)*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
Aluminum	7429-90-5	NS	200	32.61	200
Antimony	7440-36-0	3	6.0	3.04	6.0
Arsenic	7440-38-2	25	3.0	1.97	3.0
Barium	7440-39-3	1,000	200	0.80	200
Beryllium	7440-41-7	3	1.0	0.35	1.0
Cadmium	7740-43-9	5	3.0	0.28	3.0
Calcium	7440-70-2	NS	5,000	22.89	5,000
Chromium (trivalent)	7440-47-3	50	10.0	0.77	10.0
Chromium (hexavalent)	18540-29-9	50	10.0	3.1	10.0
Cobalt	7440-48-4	NS	50.0	0.54	50.0
Copper	7740-50-8	200	10.0	1.86	10.0
Iron	7439-89-6	300	100	20.90	100
Lead	7439-92-1	25	3.0	2.31	3.0
Magnesium	7439-95-4	35,000	5,000	49.34	5,000
Manganese	7439-96-5	300	15.0	0.18	15.0
Mercury	7439-97-6	0.7	0.2	0.0692	0.2
Nickel	7440-02-0	100	10.0	0.79	10.0
Potassium	7440-09-7	NS	10,000	65.10	10,000
Selenium	7782-49-2	10	10.0	3.29	10.0
Silver	7440-22-4	50	10.0	1.32	10.0
Sodium	7440-23-5	20,000	10,000	35.48	10,000
Thallium	7440-28-0	0.5	2.0	1.73	2.0
Tin	7440-31-5	NS	10.0	1.91	10.0
Vanadium	7440-62-2	NS	50.0	0.70	50.0
Zinc	7440-66-6	2,000	20.0	4.89	20.0

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
* MDLs are updated annually and will be evaluated at the time of sample analysis.
NS – None specified
Gray shaded cells indicate project action limit will not be achieved.

QAPP Worksheet #15-4

Matrix: *Groundwater*
Analytical Group: *Cyanide*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
Cyanide	57-12-5	200	10	2.4	10

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
* MDL is updated annually and will be evaluated at the time of sample analysis.

QAPP Worksheet #15-5

Matrix: *Groundwater*
Analytical Group: *Pesticides*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
4,4'-DDD	72-54-8	0.3	0.01	0.0065	0.01
4,4'-DDE	72-55-9	0.2	0.01	0.0061	0.01
4,4'-DDT	50-29-3	0.2	0.01	0.0051	0.01
Aldrin	309-00-2	0.0042	0.01	0.0042	0.01
alpha-BHC	319-84-6	0.01	0.01	0.0065	0.01
alpha-Chlordane	5103-71-9	NS	0.01	0.0061	0.01
beta-BHC	319-85-7	0.04	0.01	0.0086	0.01
delta-BHC	319-86-8	0.04	0.01	0.0064	0.01
Dieldrin	60-57-1	0.004	0.01	0.005	0.01
Endosulfan I	959-98-8	NS	0.01	0.0064	0.01
Endosulfan II	33213-65-9	NS	0.01	0.0066	0.01
Endosulfan sulfate	1031-07-8	NS	0.01	0.0073	0.01
Endrin	72-20-8	0.0045	0.01	0.0045	0.01
gamma-BHC (Lindane)	58-89-9	0.05	0.01	0.0052	0.01
Heptachlor	76-44-8	0.04	0.01	0.0049	0.01

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
* MDL is updated annually and will be evaluated at the time of sample analysis.
NS – Not specified
Gray shaded cells indicate project action limit will not be achieved.

QAPP Worksheet #15-6

Matrix: *Groundwater*
Analytical Group: *Herbicide*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
2,4,5-TP (Silvex)	93-72-1	0.26	0.1	0.055	0.1

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
* MDL is updated annually and will be evaluated at the time of sample analysis.

QAPP Worksheet #15-7

Matrix: *Groundwater*
Analytical Group: *PCB Aroclors*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) µg/L[1]	Project Quantitation Limit µg/L	Achievable Laboratory Limits	
				MDLs* µg/L	QLs µg/L
Aroclor 1016	12674-11-2	NS	0.5	0.2	0.5
Aroclor 1221	11104-28-2	NS	0.5	0.31	0.5
Aroclor 1232	11141-16-5	NS	0.5	0.26	0.5
Aroclor 1242	53469-21-9	NS	0.5	0.21	0.5
Aroclor 1248	12672-29-6	NS	0.5	0.25	0.5
Aroclor 1254	11097-69-1	NS	0.5	0.066	0.5
Aroclor 1260	11096-82-5	NS	0.5	0.15	0.5
Total PCBs	1336-36-3	0.09	0.5	NA	0.5

[1] – Technical and Operational Guidance Series (1.1.1) Ambient Water Quality Standards and Guidance Values
[2] – Total PCBs is the sum of Aroclors 1016-1260.
* MDL is updated annually and will be evaluated at the time of sample analysis.
NA – Not applicable
NS – Not specified
Gray shaded cells indicate project action limit will not be achieved.

QAPP Worksheet #15-8

Matrix: *Soil*
Analytical Group: *Volatiles*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil (mg/kg)[2]	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
1,1,1-Trichloroethane	71-55-6	100	8,100	0.002	0.00015	0.002
1,1-Dichloroethane	75-34-3	26	360	0.001	0.00014	0.001
1,1-Dichloroethene	75-35-4	100	230	0.001	0.00059	0.001
1,2,4-Trimethylbenzene	120-82-1	52	58	0.002	0.0002	0.002
1,2-Dichlorobenzene	95-50-1	100	1,800	0.001	0.00012	0.001
1,2-Dichloroethane	107-06-2	3.1	31	0.001	0.00013	0.001
1,3,5-Trimethylbenzene	108-67-8	52	780	0.002	0.00019	0.002
1,3-Dichlorobenzene	541-73-1	49	NS	0.001	0.00016	0.001
1,4-Dichlorobenzene	106-46-7	13	260	0.001	0.00023	0.001
1,4-Dioxane	123-91-1	13	530	0.13	0.016	0.13
2-Butanone (MEK)	78-93-3	100	27,000	0.01	0.0019	0.01
Acetone	67-64-1	100	61,000	0.01	0.0022	0.01
Benzene	71-43-2	4.8	82	0.0005	0.00013	0.0005
Carbon tetrachloride	56-23-5	2.4	65	0.002	0.00023	0.002
Chlorobenzene	108-90-7	100	280	0.002	0.00016	0.002
Chloroform	67-66-3	49	32	0.002	0.00015	0.002
cis-1,2-Dichloroethene	156-59-2	100	160	0.001	0.00078	0.001
Ethylbenzene	100-41-4	41	580	0.001	0.00016	0.001
m,p-Xylene	108-38-3 / 106-42-3	NS	550 / 560	0.001	0.00035	0.001
Methyl tert-butyl ether	1634-04-4	100	4,700	0.001	0.00015	0.001
Methylene chloride	75-09-2	100	350	0.005	0.00098	0.005
n-Butylbenzene	104-51-8	100	3,900	0.002	0.00015	0.002

QAPP Worksheet #15-8

Matrix: *Soil*
Analytical Group: *Volatiles*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil (mg/kg)[2]	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
n-Propylbenzene	103-65-1	100	3,800	0.002	0.00023	0.002
o-Xylene	95-47-6	NS	650	0.001	0.00027	0.001
sec-Butylbenzene	135-98-8	100	7,800	0.002	0.00017	0.002
tert-Butylbenzene	98-06-6	100	7,800	0.002	0.00021	0.002
Tetrachloroethene	127-18-4	19	81	0.002	0.0003	0.002
Toluene	108-88-3	100	4,900	0.001	0.00021	0.001
trans-1,2-Dichloroethene	156-60-5	100	1,600	0.001	0.00059	0.001
Trichloroethene	79-01-6	21	4.10	0.001	0.00015	0.001
Vinyl chloride	75-01-4	0.9	5.90	0.002	0.0002	0.002
Xylenes (total)	1330-20-7	100	580	0.001	0.00027	0.001

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDLs are updated annually and will be evaluated at the time of sample analysis.
NS – None specified

QAPP Worksheet #15-9

Matrix: *Soil*
Analytical Group: *Semivolatiles*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil mg/kg[2]	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
2-Methylphenol	95-48-7	100	3,200	0.067	0.048	0.067
3-Methylphenol**	108-39-4	100	3,200	0.067	0.032	0.067
4-Methylphenol**	106-44-5	100	6,300	0.067	0.032	0.067
Acenaphthene	83-32-9	100	3,600	0.033	0.031	0.033
Acenaphthylene	208-96-8	100	NS	0.033	0.0035	0.033
Anthracene	120-12-7	100	18,000	0.033	0.0029	0.033
Benzo(a)anthracene	56-55-3	1	16.00	0.033	0.0064	0.033
Benzo(a)pyrene	50-32-8	1	1.60	0.033	0.0071	0.033
Benzo(b)fluoranthene	205-99-2	1	16	0.033	0.0069	0.033
Benzo(g,h,i)perylene	191-24-2	100	NS	0.033	0.01	0.033
Benzo(k)fluoranthene	207-08-9	3.9	160	0.033	0.0074	0.033
Chrysene	218-01-9	3.9	1,600	0.033	0.0054	0.033
Dibenzo(a,h)anthracene	53-70-3	0.33	1.60	0.033	0.012	0.033
Dibenzofuran	132-64-9	59	73	0.067	0.0046	0.067
Fluoranthene	206-44-0	100	2,400	0.033	0.0041	0.033
Fluorene	86-73-7	100	2,400	0.033	0.004	0.033

QAPP Worksheet #15-9

Matrix: *Soil*
Analytical Group: *Semivolatiles*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil mg/kg[2]	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
Hexachlorobenzene	118-74-1	1.2	21	0.067	0.0066	0.067
Indeno(1,2,3-cd)pyrene	193-39-5	0.5	16	0.033	0.017	0.033
Naphthalene	91-20-3	100	130	0.033	0.0053	0.033
Pentachlorophenol	87-86-5	6.7	100	0.17	0.081	0.17
Phenanthrene	85-01-8	100	NS	0.033	0.0037	0.033
Phenol	108-95-2	100	19,000	0.067	0.025	0.067
Pyrene	129-00-0	100	1,800	0.033	0.0042	0.033

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDLs are updated annually and will be evaluated at the time of sample analysis.
** QL and MDL are for 3&4-methylphenol. Result will be reported as 3&4-methylphenol.

QAPP Worksheet #15-10

Matrix: *Soil*
Analytical Group: *Metals*
Concentration Level: *Low*

	Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)					
					Achievable Laboratory Limits	
Analyte	**CAS Number**	**Project Action Limit (PAL) mg/kg[1]**	**EPA Removal Management Levels for Residential Soil mg/kg[2]**	**Project Quantitation Limit mg/kg**	**MDLs* mg/kg**	**QLs mg/kg**
Aluminum	7429-90-5	NS	77,000	50.0	3.249	50.0
Antimony	7440-36-0	NS	31	2.0	0.310	2.0
Arsenic	7440-38-2	16	35	2.0	0.136	2.0
Barium	7440-39-3	400	15,000	20.0	0.054	20.0
Beryllium	7440-41-7	72	160	0.2	0.041	0.2
Cadmium	7740-43-9	4.3	71	0.5	0.051	0.5
Calcium	7440-70-2	NS	NS	500.0	2.703	500.0
Chromium (trivalent)	7440-47-3	180	NS	1.0	0.099	1.0
Chromium (hexavalent)	18540-29-9	110	30	0.4	0.19	0.4
Cobalt	7440-48-4	NS	23	5.0	0.040	5.0
Copper	7740-50-8	270	3,100	2.5	0.140	2.5
Iron	7439-89-6	NS	55,000	50.0	3.283	50.0
Lead	7439-92-1	400	400	2.0	0.239	2.0
Magnesium	7439-95-4	NS	NS	500.0	8.950	500.0
Manganese	7439-96-5	2,000	NS	1.5	0.036	1.5
Mercury	7439-97-6	0.81	11	0.0330	0.0112	0.0330
Nickel	7440-02-0	310	1,500	4.0	0.096	4.0
Potassium	7440-09-7	NS	NS	1000.0	7.423	1000.0

QAPP Worksheet #15-10

Matrix: *Soil*
Analytical Group: *Metals*
Concentration Level: *Low*

	Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)					
					Achievable Laboratory Limits	
Analyte	**CAS Number**	**Project Action Limit (PAL) mg/kg[1]**	**EPA Removal Management Levels for Residential Soil mg/kg[2]**	**Project Quantitation Limit mg/kg**	**MDLs* mg/kg**	**QLs mg/kg**
Selenium	7782-49-2	180	390	2.0	0.250	2.0
Silver	7440-22-4	180	NS	0.5	0.183	0.5
Sodium	7440-23-5	NS	NS	1000.0	1.506	1000.0
Thallium	7440-28-0	NS	0.78	1.0	0.190	1.0
Tin	7440-31-5	NS	47,000	5.0	1.121	5.0
Vanadium	7440-62-2	NS	390	5.0	0.074	5.0
Zinc	7440-66-6	10,000	23,000	2.0	0.768	2.0

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDLs are updated annually and will be evaluated at the time of sample analysis.
NS – None specified

QAPP Worksheet #15-11

Matrix: *Soil*
Analytical Group: *Cyanide*
Concentration Level: *Low*

	Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)					
					Achievable Laboratory Limits	
Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil mg/kg[2]	Project Quantitation Limit mg/kg	MDLs* mg/kg	QLs mg/kg
Cyanide	57-12-5	27	2.70	0.24	0.067	0.24

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDL is updated annually and will be evaluated at the time of sample analysis.

QAPP Worksheet #15-12

Matrix: *Soil*
Analytical Group: *Pesticides*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil mg/kg[2]	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
4,4'-DDD	72-54-8	13	230	0.00067	0.00025	0.00067
4,4'-DDE	72-55-9	8.9	200	0.00067	0.00022	0.00067
4,4'-DDT	50-29-3	7.9	37	0.00067	0.00026	0.00067
Aldrin	309-00-2	0.097	2.30	0.00067	0.0006	0.00067
alpha-BHC	319-84-6	0.48	8.60	0.00067	0.00045	0.00067
alpha-Chlordane	5103-71-9	4.2	NS	0.00067	0.00036	0.00067
beta-BHC	319-85-7	0.36	30	0.00067	0.00041	0.00067
delta-BHC	319-86-8	100	NS	0.00067	0.00026	0.00067
Dieldrin	60-57-1	0.2	3.20	0.00067	0.00052	0.00067
Endosulfan I	959-98-8	24**	NS	0.00067	0.00022	0.00067
Endosulfan II	33213-65-9	24**	NS	0.00067	0.00063	0.00067
Endosulfan sulfate	1031-07-8	24**	NS	0.00067	0.00038	0.00067
Endrin	72-20-8	11	19	0.00067	0.00024	0.00067
gamma-BHC (Lindane)	58-89-9	1.3	21	0.00067	0.0003	0.00067
Heptachlor	76-44-8	2.1	13	0.00067	0.00055	0.00067

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDLs are updated annually and will be evaluated at the time of sample analysis.
**PAL is for the sum of endosulfan I, endosulfan II, and endosulfan sulfate.

QAPP Worksheet #15-13

Matrix: *Soil*
Analytical Group: *Herbicide*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil mg/kg[2]	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
2,4,5-TP (Silvex)	93-72-1	100	510	0.0067	0.002	0.0067

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDL is updated annually and will be evaluated at the time of sample analysis.

QAPP Worksheet #15-14

Matrix: *Soil*
Analytical Group: *PCB Aroclors*
Concentration Level: *Low*

Contaminants of Concern and Other Target Analytes Table (Reference Limit and Evaluation Table)

Analyte	CAS Number	Project Action Limit (PAL) mg/kg[1]	EPA Removal Management Levels for Residential Soil	Project Quantitation Limit mg/kg	Achievable Laboratory Limits	
					MDLs* mg/kg	QLs mg/kg
Aroclor 1016	12674-11-2	NS	4.10	0.034	0.011	0.034
Aroclor 1221	11104-28-2	NS	20	0.034	0.02	0.034
Aroclor 1232	11141-16-5	NS	17	0.034	0.011	0.034
Aroclor 1242	53469-21-9	NS	23	0.034	0.015	0.034
Aroclor 1248	12672-29-6	NS	NS	0.034	0.01	0.034
Aroclor 1254	11097-69-1	NS	1.20	0.034	0.015	0.034
Aroclor 1260	11096-82-5	NS	24	0.034	0.014	0.034
Total PCBs	1336-36-3	1	23	0.034	NA	0.034

[1] – NYSDEC Part 375-6.8(b) Soil Cleanup Objectives for Restricted Residential Use
[2] – EPA Removal Management Levels for Residential Soil (HQ=1), November 2015
* MDL is updated annually and will be evaluated at the time of sample analysis.
NA – Not applicable
NS – Not specified

QAPP Worksheet #16

Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable
		Anticipated Date(s) of Initiation	Anticipated Date of Completion	
Health and Safety Plan Preparation	TRC	2/15/2016	2/24/2016	Health and Safety Plan
QAPP Preparation	TRC	2/22/2016	2/24/2016	QAPP
QAPP Approval	NYC DPR	2/24/2016	2/25/2016	Not Applicable
	USEPA	3/17/2016	3/20/2016	Not Applicable
Infiltration Testing / Geotechnical Sampling	TRC	3/21/2016	3/28/2016	Not Applicable
Laboratory Analyses	Accutest	3/28/2016	4/4/2016	Not Applicable
Project Reports	TRC	4/4/2016	4/18/2016	Infiltration Letter Report

QAPP Worksheet #17

Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Infiltration Tests and Soil and Groundwater Sampling and Analysis

- Five (5) borings will be advanced across the Site to at least one (1) foot below the observed groundwater table (estimated to be 8.5 to 10.5 feet bgs) for infiltration testing.
- The infiltration tests will be performed in accordance with the NYCDEP Office of Green Infrastructure procedures as described in the Procedure Governing Limited Geotechnical Investigation for Green Infrastructure Practices dated April 2015.
- Soil samples will be collected from the five (5) borings at up to three intervals depending on the groundwater depth (2-4 feet, 5-7 feet, and 8-10 feet) for a total of fifteen (15) soil samples (depending on how deep the water table is, assuring that the deepest sample collected is within one foot above the water table).
- A temporary well point will be installed at each boring. Five (5) groundwater samples, one from each temporary well point, will be collected.
- The fifteen (15) soil samples and five (5) groundwater samples will be analyzed by the same methods and parameters discussed in Worksheet #14.
- Quality Assurance and Quality Control sampling, including field blanks, site-specific matrix spike and matrix-spike duplicates (MS/MSD), equipment blanks and blind duplicate samples will be collected at a rate of one per 20 samples for soil (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate) and groundwater (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate). NYSDEC Analytical Services Protocol (ASP) Category B/Level 4 analytical data packages will be provided by the laboratory. TRC will perform 100% validation of the data and prepare a Data Validation Report.

The results of the infiltration testing will provide data for the design of green infrastructure to dissipate increased stormwater runoff volumes that are anticipated for the fields that may be covered with synthetic turf. The purpose of the infiltration testing and concurrent soil and groundwater sampling is to obtain background data that NYSDEC may request before approving the installation of green infrastructure that would allow water to infiltrate soils known to be contaminated with metal constituents.

Infiltration Testing

The infiltration testing will be performed in accordance with the NYCDEP Office of Green Infrastructure procedures as outlined in the Procedure Governing Limited Geotechnical Investigation for Green Infrastructure Practices dated April 2015. Infiltration testing will be performed at five (5) boring locations utilizing a 4-inch inner diameter drilled casing to the required depth. Installation procedures include the following:

- Standard Penetration Test;
- Soil Sampling;

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Sampling Design and Rationale

- Permeability Testing; and
- Temperature Measurement.

Standard Penetration Testing

- In each soil boring location, a Standard Penetration Test (SPT) will be conducted continuously in accordance with ASTM D1586 (i.e., a 24-inch long, 2-inch outside diameter split-barrel sampler driven by blows from a 140-pound hammer falling freely from a height of 30 inches) to the depth specified in Section 2.3.4 of the Procedure Governing Limited Geotechnical Investigation for Green Infrastructure Practices dated April 2015 (the "Procedure"). The number of blows required to drive the 24-inch split-barrel sampler every 6-inch increment will be recorded. The Standard Penetration Resistance (N-value) will be determined as the sum of the blows required to drive the sampler to the second and third 6-inch increments.

Soil Sampling and Analysis

The field personnel will make visual observations for the soil at all depths at the time of the SPT, and record all pertinent observations as soil descriptions in the boring logs.

Soil samples that are representative of the actual recovered soil core will be collected at specific depth intervals for laboratory analysis. Collected samples will be stored in labeled jars, to be delivered to a NYSDOH ELAP-certified analytical laboratory for subsequent examination and testing. Soil samples will be collected from the five (5) borings at 2-4 feet, 5-7 feet, and 8-10 feet bgs for a total of fifteen (15) soil samples (depending on how deep the water table is, assuring that the deepest sample collected is within one foot above the water table).
Stainless-steel equipment used during field-sampling activities will be decontaminated in accordance to NYSDEC DER-10 and applicable TRC SOPs (refer to Worksheet #21) prior to and subsequent to sampling. Decontamination of sampling equipment will be conducted as follows:

- Alconox detergent and potable water scrub
- Potable water rinse
- Air dry (sufficient time will be allowed for the equipment to completely dry)

The soil samples will be analyzed for 6 NYCRR Part 375-6.8(b)-listed parameters below and the following additional metals: aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin. The following analytical methods will be used:

- Part 375 VOCs: EPA Method 8260C (if PID readings exceed 5 ppm above background concentrations)
- Part 375 SVOCs: EPA Method 8270D
- Part 375 Pesticides: EPA Method 8081B
- Part 375 Herbicide – Silvex: EPA Method 8151

QAPP Worksheet #17

Sampling Design and Rationale

- TCL PCBs: EPA Method 8082A
- TAL Metals: EPA Method 6010C (and 7471B for mercury and 7196A for hexavalent chromium)
- Cyanide: EPA Method 9012B

Quality Assurance and Quality Control sampling, including field blanks, site-specific matrix spike and matrix-spike duplicates (MS/MSD), equipment blanks and blind duplicate samples will be collected at a rate of one per 20 samples for soil (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate) and groundwater (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate). NYSDEC Analytical Services Protocol (ASP) Category B/Level 4 analytical data packages will be provided by the laboratory. TRC will perform 100% validation of the data and prepare a Data Validation Report..

Permeability Test Procedure

The permeability test (PT) procedure will be conducted at five (5) locations and will be performed as follows:

- The 4-inch inner diameter casing shall be driven to the required test depth (refer to soil boring procedure for allowable equipment). The space (annulus) between the casing and borehole must be kept at a minimum. If the casing cannot be driven and a larger hole is first bored to allow for the casing, the annulus must be properly sealed before any water is introduced for testing into the casing.
- Measure the depth to the bottom of the hole to the nearest inch.
- Ensure that the depth to the bottom of the hole is within 1 inch of the depth to the bottom of the casing.
- Place approximately 6 - 8 inches of coarse sand (4.75mm – 2mm) at the bottom of the casing.
- Wash out casing at low water pressure (the water shall not disturb the coarse sand layer at the bottom of the casing) using clean water until the water exiting the casing runs clear.
- Saturate the soil beneath the bottom of the casing for at least thirty (30) minutes using clean water.
- Fill casing to the top with clean water and record the temperature of the water (see below for details on temperature measurement).
- Record the time at the beginning of the test.
- Record the falling water level in the casing at 1, 2, 3, 4, 5, 10, and 15 minutes after the beginning of the test or until the water level in the casing has stopped falling.
- At the conclusion of the test, fill the casing to the top with clean water and maintain the water at this level for five (5) minutes.
- Repeat the test once for each PT depth using the same procedure.

Clean water must be used in conducting PTs; PTs conducted using “dirty water” create faulty results and will be rejected.

If a soil boring was conducted within 20 ft of a planned PT location, the borehole from the soil boring must be completely backfilled before the PT is

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Sampling Design and Rationale

commenced.

The field personnel must maintain continuous data of PTs and report them accurately in Permeability Test Logs (PT Logs). Refer to Section 3.1.3 in the Procedure for details on the PT Log. Permeability tests will not be performed when the ambient temperature is below 0°C.

Stainless-steel equipment used during field-sampling activities will be decontaminated in accordance to NYSDEC DER-10 and applicable TRC SOPs (refer to Worksheet #21) prior to and subsequent to sampling. Decontamination of sampling equipment will be conducted as follows:

- Alconox detergent and potable water scrub
- Potable water rinse
- Air dry (sufficient time will be allowed for the equipment to completely dry)

Temperature Measurement

Temperatures will be measured in °C using equipment meeting the specifications as shown in Table 1 below and calibrated against a National Institute of Standards and Technology NIST certified thermometer.

Table 1 – Acceptable Temperature Measurement Equipment

Equipment	Specifications
Liquid-in-glass thermometer (non-mercury)	• Temperature range, at least -5 to +45°C • 0.5°C gradations or smaller • Calibrated accuracy within 1 percent of full scale or 0.5°C, whichever is less
Thermistor	• Calibrated accuracy within 0.1 to 0.2°C • Digital readout to at least 0.1°C

Groundwater Sampling and Analysis

QAPP Worksheet #17

Sampling Design and Rationale

Groundwater sampling will be conducted in accordance with NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation and will include the following:

- The advancement of five (5) borings utilizing a track mounted direct drive drill rig (i.e., Geoprobe) to at least one (1) foot below the observed groundwater table (estimated to be 8.5 to 10.5 feet bgs) for installation of temporary 1-inch diameter PVC monitoring wells below the water table. The borings will extend continuously to the terminal depth of the boring.

- Groundwater samples will be collected using a peristaltic pump connected to dedicated Teflon lined tubing. Prior to the collection of groundwater samples, sample locations will be purged until groundwater turbidity reaches a minimum (e.g., less than 50 NTUs is the goal) and other parameters stabilize. If a monitoring well is dewatered during purging, a sample will be collected immediately following the well recharging. Additionally, conductivity, salinity, dissolved oxygen, pH, temperature, and turbidity will be monitored using a Horiba™ water quality meter during purging.

- Groundwater samples will be collected and containerized in appropriate laboratory supplied glassware (i.e., 2 oz, 4 oz, or 8 oz) in accordance with NYSDEC/EPA protocols. Each container will be properly labeled, preserved, and placed in a cooler for transport via courier to Accutest and standard COC procedures will be followed.

- The groundwater samples will be analyzed for 6 NYCRR Part 375-6.8(b)-listed parameters below and the following additional metals: aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin. The following analytical methods will be used:

    - Part 375 VOCs: EPA Method 8260C (if soil exhibits VOCs at concentrations greater than 5 ppm above background concentrations)
    - Part 375 SVOCs: EPA Method 8270D
    - Part 375 Pesticides: EPA Method 8081B
    - Part t375 Herbicide – Silvex: EPA Method 8151
    - TCL PCBs: EPA Method 8082A
    - TAL Metals (Total and Dissolved): EPA Method 6010C (and 7470A for mercury and 7196A for hexavalent chromium) (**field filtered and unfiltered**)
    - Cyanide: EPA Method 9012B

Quality Assurance and Quality Control sampling, including field blanks, site-specific matrix spike and matrix-spike duplicates (MS/MSD), equipment blanks and blind duplicate samples will be collected at a rate of one per 20 samples for groundwater (one Duplicate, one Equipment Blank, one Matrix Spike, one Matrix Spike Duplicate). NYSDEC Analytical Services Protocol (ASP) Category B/Level 4 analytical data packages will be provided by the laboratory. TRC will

QAPP Worksheet #17

Sampling Design and Rationale

perform 100% validation of the data and prepare a Data Validation Report..

The water quality meter (i.e., Horiba) used during groundwater sampling activities will be decontaminated in accordance with NYSDEC DER-10 and applicable TRC SOPs (refer to Worksheet #21) subsequent to sampling. Decontamination of sampling equipment will be conducted as follows:

- Alconox detergent and potable water scrub
- Potable water rinse
- Air dry (sufficient time will be allowed for the equipment to completely dry)

Geotechnical Sampling

Geotechnical sampling will be conducted by OWEIS Engineering. Soil borings will be advanced across the Site at 15 locations to a terminal depth of 10 to 20 feet bgs. Continuous soil sampling will be conducted at each soil boring via SPT in accordance with ASTM D1586 procedures and up to 20 samples will be selected for geotechnical analysis (i.e., grain size and/or Atterberg limit determinations). Selection of soil samples for geotechnical analysis will be based on subsurface conditions.
QA/QC samples will not be collected and data validation will not be performed for the soil sampling associated with this task.

QAPP Worksheet #18

Sampling Locations and Methods/SOP Requirements Table

Location	Matrix	Depth (feet below grade)	Analytical Group	Concentration Level	Number of Samples	Sampling SOP Reference[1]	Rationale for Sampling Location
Five locations (see attached Figure 2)	NA	NA	Infiltration Test	NA	5	F-01, S-5	Obtain locations of proposed green infrastructure (i.e., stormwater infiltration basins).
Five locations (see attached Figure 2)	Groundwater	10-11	Part 375-6.8(b)-listed parameters including the following additional metals: aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin.	Low	5	S-1, S-2, S-4, S-5, S-7	Obtain locations of proposed green infrastructure (i.e., stormwater infiltration basins).
Five locations (see attached Figure 2)	Soil	2-4	Part 375-6.8(b)-listed parameters including the following additional metals: aluminum, antimony, calcium, total chromium, cobalt, iron, magnesium, potassium, sodium, thallium, vanadium, and tin.	Low	15	S-2, S-3, S-4, S-5, S-6	Obtain locations of proposed green infrastructure (i.e., stormwater infiltration basins).
		5-7					
		8-10					
15 soil borings(see attached Figure 2)	Soil	TBD based on subsurface conditions	Grain size and/or Atterberg limit determinations.	NA	Up to 20	ASTM D422 ASTM D4318	Boring locations provide adequate coverage for site-wide geotechnical conditions.

[1]Reference number corresponds to Worksheet #21.
Sample naming scheme is defined on Worksheet #27.
NA – Not applicable.

QAPP Worksheet #19

Analytical SOP Requirements Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation Method/ SOP Reference	Sample Volume	Containers* (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Groundwater	VOCs	Low	L-01	3 x 40 mL	3 x 40 mL VOA vials	pH < 2 w/ HCl; Cool, 4ºC; no headspace	14 days to analysis
Groundwater	SVOCs	Low	L-02	2 x 1 L	2 x 1 L amber glass bottles	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
Groundwater	Metals (unfiltered)	Low	L-03, L-04	1 x 500 mL	1 x 500 mL polyethylene	pH < 2 w/ HNO_3; Cool, 4ºC	Mercury: 28 days to analysis Other Metals: 180 days to analysis
Groundwater	Metals (filtered)	Low	L-03, L-04	1 x 500 mL	1 x 500 mL polyethylene	pH < 2 w/ HNO_3; Cool, 4ºC	Mercury: 28 days to analysis Other Metals: 180 days to analysis
Groundwater	Hexavalent chromium (filtered and unfiltered)	Low	L-05	1 x 125 mL	1 x 125 mL amber glass bottles	Cool, 4ºC	24 hours to analysis
Groundwater	Cyanide	Low	L-06	1 x 100 mL	1 x 100 mL glass bottle	NaOH to pH >12, Cool, 4ºC	14 days to analysis
Groundwater	Pesticides	Low	L-07	2 x 1 L	2 x 1 L amber glass bottles	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
Groundwater	Herbicide: Silvex	Low	L-08	2 x 1 L	2 x 1 L amber glass bottles	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis
Groundwater	PCBs	Low	L-09	2 x 1 L	2 x 1 L amber glass bottles	Cool, 4ºC	7 days to extraction; 40 days from extraction to analysis

QAPP Worksheet #19

Analytical SOP Requirements Table

Matrix	Analytical Group	Conc. Level	Analytical and Preparation Method/ SOP Reference	Sample Volume	Containers* (Number, size and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Soil	VOCs	Low	L-01	3 x 5g	3 x 5g EnCore® samplers	Sealed in EnCore® bag; Cool, 4ºC	Low-level: 2 EnCores®: 48 hours to extract in 5 mL DI water; freeze vial to < -7ºC; 14 days to analysis High-level: 1 EnCore®: 48 hours to extract in 5 mL methanol; 14 days to analysis
Soil	SVOCs	Low	L-02	1 x 4 oz	1 x 4 oz. glass jar	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
Soil	Metals	Low	L-03	1 x 4 oz	1 x 4 oz. glass jar	Cool, 4ºC	180 days to analysis
Soil	Mercury	Low	L-10	1 x 4 oz	1 x 4 oz. glass jar	Cool, 4ºC	28 days to analysis
Soil	Hexavalent chromium	Low	L-11	1 x 4 oz.	1 x 4 oz. glass jar	Cool, 4ºC	30 days to digestion; 7 days from digestion to analysis
Soil	Cyanide	Low	L-06	1 x 4 oz.	1 x 4 oz. glass jar	Cool, 4ºC	14 days to analysis
Soil	Pesticides	Low	L-07	1 x 4 oz	1 x 4 oz. glass jar	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
Soil	Herbicide: Silvex	Low	L-08	1 x 4 oz	1 x 4 oz. glass jar	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
Soil	PCBs	Low	L-09	1 x 4 oz	1 x 4 oz. glass jar	Cool, 4ºC	14 days to extraction; 40 days from extraction to analysis
Soil	Grain Size	NA	ASTM D422	1 x 16 oz	Not specified	NA	NA
Soil	Atterberg Limit Determination	NA	ASTM D4318	1 x 16 oz	Not specified	NA	NA

QAPP Worksheet #20

Field and Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical Method/ SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. Equipment Blanks	No. Matrix Spike	No. Matrix Spike Duplicates	No. Trip Blanks
Groundwater	VOCs	Low	L-01	5	1	1	1	1	1 Per Cooler (if VOC sample collected)
Groundwater	SVOCs	Low	L-02	5	1	1	1	1	0
Groundwater	Metals (unfiltered)	Low	L-03	5	1	1	1	1	0
Groundwater	Metals (filtered)	Low	L-03	5	1	1	1	1	0
Groundwater	Mercury (unfiltered)	Low	L-04	5	1	1	1	1	0
Groundwater	Mercury (filtered)	Low	L-04	5	1	1	1	1	0
Groundwater	Hexavalent chromium (filtered)	Low	L-05	5	1	1	1	1	0
Groundwater	Hexavalent chromium (unfiltered)	Low	L-05	5	1	1	1	1	0
Groundwater	Cyanide	Low	L-06	5	1	1	1	1	0
Groundwater	Pesticides	Low	L-07	5	1	1	1	1	0
Groundwater	Herbicide: Silvex	Low	L-08	5	1	1	1	1	0
Groundwater	PCBs	Low	L-09	5	1	1	1	1	0
Soil-Infiltration test	VOCs	Low	L-01	15	1	1	1	1	1 per cooler (if VOC sample collected)

QAPP Worksheet #20

Field and Quality Control Sample Summary Table

Matrix	Analytical Group	Conc. Level	Analytical Method/ SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs	No. Equipment Blanks	No. Matrix Spike	No. Matrix Spike Duplicates	No. Trip Blanks
Soil-Infiltration test	SVOCs	Low	L-02	15	1	1	1	1	0
Soil-Infiltration test	Metals	Low	L-03	15	1	1	1	1	0
Soil-Infiltration test	Mercury	Low	L-10	15	1	1	1	1	0
Soil-Infiltration test	Hexavalent chromium	Low	L-11	15	1	1	1	1	0
Soil-Infiltration test	Cyanide	Low	L-06	15	1	1	1	1	0
Soil-Infiltration test	Pesticides	Low	L-07	15	1	1	1	1	0
Soil-Infiltration test	Herbicide: Silvex	Low	L-08	15	1	1	1	1	0
Soil-Infiltration test	PCBs	Low	L-09	15	1	1	1	1	0
Soil-Geotechnical Sample	Grain Size	Low	ASTM D422	Up to 20	1	0	0	0	0
Soil-Geotechnical Sample	Atterberg Limit Determination	Low	ASTM D4318	Up to 20	15	15	15	15	15
NA	Infiltration Testing	NA	F-01	5	NA	NA	NA	NA	NA

QAPP Worksheet #21

Project Sampling SOP References Table

Reference Number[1]	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work Y or N	Comments
S-1	TRC SOP RMD 009: Groundwater Sampling, August 2014	TRC	Peristaltic pump, sample bottles, water quality meter, flow-through cell, stopwatch	N	None
S-2	TRC SOP RMD 010: Equipment Decontamination, April 2014	TRC	Alconox, deionized water, scrub brushes, wash basins, polyethylene sheeting	N	None
S-3	TRC SOP RMD 005: Visual-Manual Procedure for Soil Description and Identification, September 2013	TRC	Sand grading chart, field logbook, folding ruler, polyethylene sheeting	N	None
S-4	TRC SOP RMD 002: Chain of Custody Procedures, March 2013	TRC	Chains of custody, custody seals, sample labels	N	None
S-5	TRC SOP RMD 001: Field Activity Documentation for Environmental Investigations, January 2013	TRC	Field Logbooks	N	None
S-6	TRC SOP RMD 003: Soil Sampling, September 2013	TRC	Stainless steel trowel/shovel, stainless steel spoons and bowls	N	None.
S-7	TRC SOP RMD 011: Calibration of Field Instruments for Water Quality Parameters, November 2014	TRC	Water quality meter, turbidity meter, calibration solutions, ring stand	N	None

QAPP Worksheet #22

Field Equipment Calibration, Maintenance, Testing and Inspection Table

Sampling Equipment/ Instrument	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person
Peristaltic Pump	NA	Replace flexible tubing between wells	NA	Visual inspection for defective parts	Each pump prior to use	No visually defective parts	Replace parts; use backup pump	Field Team Manager
Horiba® Multi-Parameter Water Quality Meter with flow-through cell (or equivalent)	Calibrate probe with Auto-Cal Solution	Rinse Horiba and flow-through cell between wells or if giving erratic results	NA	NA	Calibration check: -Daily-before use - If instrument gives erratic results	All parameters sufficiently stabilize within 10% over three readings spaced 3 minutes apart	If probe reading fails to stabilize, replace unit.	Field Team Manager
Electronic Water-Level Indicator	Calibrate with measuring tape	Decontaminate between wells	Test in bucket with water and Alconox	NA	Daily before use	± 0.1 feet No dirty parts No defective parts noted	Clean and/or replace	Field Team Manager
PID	Calibrate with 100 ppmV isobutylene standard. Blank: zero air check	Replace filter as needed	Take reading of calibration gas post calibration	NA	Calibration check: -Daily-before use - If instrument gives erratic results	± 10% of true value	Recalibrate or service; rerun affected sample.	Field Team Manager
Trimble® GeoXT™ handheld	NA	NA	NA	NA	NA	NA	NA	NA

QAPP Worksheet #23

Analytical SOP References Table

Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group / Matrix	Instrument	Organization Performing Analysis	Modified for Project Work Y or N
L-01	Method 8260C, Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Definitive	VOCs / Soil and Groundwater	GC/MS	Accutest	N
L-02	Method 8270D, Semivolatile Organic Compounds by GC/MS	Definitive	SVOCs / Soil and Groundwater	GC/MS	Accutest	N
L-03	Metals by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP) Using Solid State ICP	Definitive	Metals / Soil and Groundwater (filtered and unfiltered)	ICP	Accutest	N
L-04	Cold Vapor Analysis of Mercury for Water Samples	Definitive	Mercury / Groundwater (filtered and unfiltered)	CVAA	Accutest	N
L-05	Hexavalent Chromium in Waters	Definitive	Hexavalent chromium / Groundwater (filtered and unfiltered)	Spectro-photometer	Accutest	N
L-06	Cyanide Distillation/Aqueous Samples/Micro Method and Cyanide (LACHAT AUTOANALYZER)	Definitive	Cyanide / Soil and Groundwater	Colorimeter	Accutest	N
L-07	Determination of Organochlorine Pesticides Using GC System	Definitive	Pesticides / Soil and Groundwater	GC/ECD	Accutest	N
L-08	SW846 8151A: Chlorinated Herbicides by GC Using Methylation Derivitization	Definitive	Herbicide: Silvex / Soil and Groundwater	GC/ECD	Accutest	N
L-09	SW846 8082A: Determination of Polychlorinated Biphenyls (PCBs) by Gas Chromatography	Definitive	PCBs / Soil and Groundwater	GC/ECD	Accutest	N
L-10	Cold Vapor Analysis of Mercury for Soil Samples	Definitive	Mercury / Soil	CVAA	Accutest	N
L-11	Hexavalent Chromium (Soils)	Definitive	Hexavalent chromium / Soil	Spectro-photometer	Accutest	N
F-01	Procedure Governing Limited Geotechnical Investigation for Green Infrastructure Practices, April 2015	Screening	In-situ Infiltration Testing	Well Casing / Stopwatch	TRC	N

QAPP Worksheet #23

Analytical SOP References Table

Reference Number	Title, Revision Date and/or Number	Definitive or Screening Data	Analytical Group / Matrix	Instrument	Organization Performing Analysis	Modified for Project Work Y or N
ASTM D 422	Standard Test Method for Particle-Size Analysis of Soils ("Grain Size")	Definitive	Soil	Sieve	TerraSense	N
ASTM D4318	Standard Test Methods for Liquid Limit , Plastic Limit, and Plasticity Index of Soils ("Atterberg Limit Determination")	Definitive	Soil	See method	TerraSense	N

GC/MS – Gas Chromatograph/Mass Spectrometer; ICP – Inductively Coupled Plasma; CVAA – Cold Vapor Atomic Absorption NA – Not Applicable ECD – Electron Capture Detector

QAPP Worksheets #24 and 25

Analytical Instrument Calibration, Equipment Maintenance[1], Testing and Inspection Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference
GC/MS	VOC and SVOC Analysis	Check connections, replace disposables, perform injection port maintenance, clip column and perform leak checks.	Initial: After instrument set up and when calibration verification fails; minimum 5 points	%RSD <30 for CCCs and minimum RF for SPCCs	Perform necessary equipment maintenance and check calibration standards	GC/MS Analysts: Accutest Laboratories	L-01, L-02
			Continuing: Daily prior to samples and every 12 hours	% D < 20 for CCCs and minimum RF for SPCCs	Perform necessary equipment maintenance and check calibration standards		
GC/ECD	Pesticide and Herbicide (Silvex) Analysis	Check connections, replace disposables, perform injection port maintenance, clip column and perform leak checks.	Initial: After instrument set up and when calibration verification fails; minimum 5 points	%RSD <20	Perform necessary equipment maintenance and check calibration standards	GC/ECD Analyst: Accutest Laboratories	L-07
			Continuing: Beginning and end of every analytical sequence and every 20 samples	% D < 20	Perform necessary equipment maintenance and check calibration standards		
GC/ECD	PCB Aroclor Analysis	Check connections, replace disposables, perform injection port maintenance, clip column and perform leak checks.	Initial: After instrument set up and when continuing calibration fails; minimum 5 points	% RSD < 20 for 1016/1260; one-point calibration for remaining Aroclors	Perform necessary equipment maintenance and check calibration standards	GC/ECD Analysts: Accutest Laboratories	L-09
			Continuing: Beginning and end of every analytical sequence and every 20 samples	% D < 20 for 1016/1260	Perform necessary equipment maintenance and check calibration standards		
ICP	Metals Analysis	Check argon tank pressure, check tubing, nebulizer, clean plasma torch assembly, clean filters,	Initial Calibration: ICP: One standard and a blank; daily prior to samples	None for ICP	Perform necessary equipment maintenance and check calibration	ICP Analyst: Accutest Laboratories	L-03

QAPP Worksheets #24 and 25

Analytical Instrument Calibration, Equipment Maintenance[1], Testing and Inspection Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference
		check o-rings.			standards		
			Initial Calibration Verification: Daily prior to samples	90-110% of true value	Perform necessary equipment maintenance and check calibration standards		
			Continuing Calibration Verification: Every 10 samples and at end of analytical run	90-110% of true value for ICP	Perform necessary equipment maintenance and check calibration standards		
Spectrophotometer	Hexavalent Chromium Analysis	Check connections, replace disposables, perform injection port maintenance, clip column, and perform leak checks	Initial: Daily prior to samples analysis; three standards and a blank	$r \geq 0.999$	Perform necessary equipment maintenance and check calibration standards	Spectrophotometer Analyst: Accutest Laboratories	L-05 & L-11
			Initial Calibration Verification: Immediately after the initial calibration	90-110% recovery	Perform necessary equipment maintenance and check calibration standards		
			Continuing: Every 10 samples and at the end of the sequence	90-110% recovery (soil) 95-105% recovery (groundwater)	Perform necessary equipment maintenance and check calibration standards		
CVAA	Mercury Analysis	Change lamp, change/clean quartz cell, check electronics.	Initial Calibration: Daily prior to samples; 6 standards and a blank	$r \geq 0.995$	Perform necessary equipment maintenance and check calibration standards	CVAA Analyst: Accutest Laboratories	L-04 & L-10
			Continuing Calibration Verification: Prior to samples, every 10 samples and at end of	90-110% recovery	Perform necessary equipment maintenance and check calibration		

QAPP Worksheets #24 and 25

Analytical Instrument Calibration, Equipment Maintenance[1], Testing and Inspection Table

Instrument	Activity	List Maintenance, Testing and Inspection Activities	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	Method/SOP Reference
			analytical run.		standards		
Colorimeter	Cyanide	Clean and change pump tubing as needed. Clean and optimize injection valve as needed.	Initial: Prior to sample analysis; five standards and a blank	$r \geq 0.995$	Perform necessary equipment maintenance and check calibration standards	Wet Chemistry Analyst: Accutest Laboratories	L-06
			Continuing: Every 10 samples	$\pm$ 10% of true value	Perform necessary equipment maintenance and check calibration standards		

[1]All instrument maintenance will be performed in accordance with manufacturers' recommendations and Accutest Laboratories' SOP requirements.
SPCC – System Performance Check Compound
RSD – Relative Standard Deviation
CCC – Continuing Calibration Compound

QAPP Worksheet #26

Sample Handling System – Analytical Tests

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field Team Manager and Field Staff/TRC
Sample Packaging (Personnel/Organization): Field Team Manager and Field Staff/TRC
Coordination of Shipment (Personnel/Organization): Field Team Manager /TRC
Type of Shipment/Carrier: Courier Service
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receiving Personnel, Accutest Laboratories
Sample Custody and Storage (Personnel/Organization): Sample Receiving Personnel, Accutest Laboratories
Sample Preparation (Personnel/Organization): Sample Custodian/Sample Preparation Manager, Accutest Laboratories
Sample Determinative Analysis (Personnel/Organization): Sample Custodian, Accutest Laboratories
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 60 days after delivery of data package
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 60 days after delivery of data package
Biological Sample Storage (No. of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: Laboratory Technician/Accutest Laboratories
Number of Days from Analysis: 60 days after delivery of data package

Sample Handling System – Geotechnical

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Geotechnical Engineer/OWEIS Engineering, Inc.
Sample Packaging (Personnel/Organization): Geotechnical Engineer/OWEIS Engineering, Inc.
Coordination of Shipment (Personnel/Organization): Geotechnical Engineer/OWEIS Engineering, Inc.
Type of Shipment/Carrier: Courier Service
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receiving Personnel, TerraSense, LLC

Sample Custody and Storage (Personnel/Organization): Sample Receiving Personnel, TerraSense, LLC
Sample Preparation (Personnel/Organization): Sample Custodian/Sample Preparation Manager, TerraSense, LLC
Sample Determinative Analysis (Personnel/Organization): Sample Custodian, TerraSense, LLC
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 60 days after delivery of data package
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 60 days after delivery of data package
Biological Sample Storage (No. of days from sample collection): Not applicable
SAMPLE DISPOSAL
Personnel/Organization: Laboratory Technician/ TerraSense, LLC
Number of Days from Analysis: 60 days after delivery of data package

QAPP Worksheet #27

Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Sample chain-of-custody and packaging procedures are summarized below. These procedures will ensure that the samples will arrive at the laboratory with the chain-of-custody intact. The TRC Field Team Manager (or designee) is responsible for overseeing and supervising the implementation of proper sample custody procedures in the field and up until the samples have been transferred to a courier. The chain-of-custody procedures are initiated in the field immediately following sample collection. The procedures consist of: (1) preparing and attaching a unique sample label to each sample collected, (2) completing the COC form, and (3) preparing and packing the samples for shipment.

The field sampler is personally responsible for the care and custody of the samples until they are transferred or dispatched properly. Field procedures have been designed such that as few people as possible will handle the samples.

- All bottles will be identified by the use of pre-printed adhesive sample labels with site name and location, sample number, sample locations, date/time of collection, type of preservation, type of analysis, and sampler's initials. The sample numbering system is presented below.
- Samples will be transported in containers (coolers) which will maintain the refrigeration temperature for those parameters for which refrigeration is required.
- Samples will be accompanied by a properly completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents the transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage location.
- TRC will follow TRC SOP RMD 002, Sample Chain-of-Custody. COC records are initiated by the samplers in the field. The field portion of the custody documentation should include: (1) the project name; (2) signatures of samplers; (3) the sample number, date and time of collection, and whether the sample is grab or composite; (4) required analyses; and (5) signatures of individuals involved in sampling. The laboratory copy of the COC should be signed and enclosed in a zip-seal bag in the cooler with the samples.
- All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler and placed in the project files.
- Samples will be properly packaged for transport via courier to the laboratory for analysis, with a separate signed custody record enclosed in and secured to the inside top of each sample box or cooler. Shipping containers will be secured for shipment to the laboratory. If an authorized laboratory courier does not pick up the samples from the project site, custody seals will be attached to the front right and back left of the cooler and covered with clear plastic tape after being signed by field personnel. Subsequently, the cooler will be strapped shut with strapping tape in at least two locations.
- Samples remain in the custody of the sampler until transfer of custody is completed. This consists of delivery of samples to the laboratory sample

QAPP Worksheet #27

Sample Custody Requirements

custodian, and signature of the laboratory sample custodian on the chain-of-custody document as receiving the samples and signature of sampler as relinquishing samples.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Samples will be received and logged in by a designated sample custodian or his/her designee. Upon sample receipt, the sample custodian will:

- examine the shipping containers to verify that the custody tape is intact,
- examine all sample containers for damage,
- determine if the temperature required for the requested testing program has been maintained during shipment and document the temperature on the COC or sample login records,
- compare samples received against those listed on the chain-of-custody,
- verify that sample holding times have not been exceeded,
- examine all shipping records for accuracy and completeness,
- determine sample pH (if applicable) and record on chain-of-custody or sample login forms,
- sign and date the COC immediately (if shipment is accepted) and attach the air bill,
- note any problems associated with the coolers and/or samples on the cooler receipt form and notify the Laboratory Project Manager, who will be responsible for contacting the TRC Project Manager,
- attach laboratory sample container labels with unique laboratory identification and test, and
- place the samples in the proper laboratory storage.

Following receipt, samples will be logged according to the following procedure:

- The samples will be entered into the laboratory tracking system. At a minimum, the following information will be entered: project name or identification, unique sample numbers (both client and internal laboratory), type of sample, required tests, date and time of laboratory receipt of samples, and field identification provided by field personnel.
- The Laboratory Project Manager will be notified of sample arrival.
- The completed COC and any additional documentation will be placed in the final evidence file.

QAPP Worksheet #27

Sample Custody Requirements

Sample Identification Procedures:

The establishment of a standard sample designation/labeling protocol is essential to ensure adequate quality assurance/quality control and to allow tracking of each sample and the associated analytical data. Proper labeling allows for the tracking of samples beginning from the time of sample collection, through analysis, and following project completion should future data correlation be deemed necessary. The proper labeling of samples is also critical in ensuring that samples are analyzed within the required sample holding times.

All samples associated with infiltration testing will be identified using a unique sample identification scheme suitable to the project and the sampling protocol. The numbering scheme includes the project descriptor (i.e., RH), soil or groundwater designation (i.e., GW), a sequential number assigned to that sample, and the depth of sample collection (for soil samples only). The samples will be labeled as follows:

Infiltration Testing Sample Identification

Soil	RH-S-XX(X-Y')
Groundwater	RH-GW-XX

Samples collected for geotechnical analysis will be identified by RHGT, followed by the soil boring number (i.e., 01-16), and the depth interval in parenthesis.

- RHGT-XX(X-Y')

The sample identification number will be recorded on the COC forms accompanying each sample shipment submitted for analysis and will be recorded in the field logbooks and soil boring logs.

Chain-of-custody Procedures:

As described above, custody is one of several factors that are necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample or evidence file is considered to be under a person's custody if

- the item is in the actual possession of a person;
- the item is in the view of the person after being in actual possession of the person;

QAPP Worksheet #27

Sample Custody Requirements

- the item was in the actual physical possession of the person but is locked up to prevent tampering; and,
- the item is in a designated and identified secure area.

An example COC is provided in Attachment 4.

QAPP Worksheet #28-1

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	VOCs					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-01					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One every 12 hours before samples	No target compounds ≥ QL (except methylene chloride, acetone and 2-butanone < 2x QL)	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL (except methylene chloride, acetone and 2-butanone < 2x QL)
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	As needed to assess carryover from high concentration samples	No target compounds ≥ QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Matrix Spike	One per 20 samples	Percent recoveries as per Worksheet #12-1/12-10	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-1
Matrix Spike Duplicates	One per 20 samples	Percent recoveries and RPDs as per Worksheet #12-1/12-10	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Percent recoveries and RPDs as per Worksheet #12-1/21-10
Surrogates	4 per sample	Percent recoveries as per Worksheet #12-1/12-10	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-1/12-10
Internal Standards (ISs)	5 per sample	Area counts: -50% ±100% of areas in associated continuing calibration standard Retention times: ± 30 seconds from retention times in associated continuing calibration standard	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Area counts: -50% ±100% of areas in associated continuing calibration standard Retention times: ± 30 seconds from retention times in associated continuing calibration standard
Laboratory Control Sample	One per 20 samples	Percent recoveries as per Worksheet #12-1/12-10	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-1/12-10

NA = Not Applicable TBD = To Be Determined

QAPP Worksheet #28-2

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	SVOCs					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-02					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	No target compounds ≥ QL (except phthalates must be ≤ 5 x QL)	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL (except phthalates must be ≤ 5 x QL)
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	As needed to assess carryover from high concentration samples	No target compounds ≥ QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL (except phthalates must be ≤ 5x QL
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Matrix Spike	One per 20 samples	Percent recoveries as per Worksheet #12-2/12-11	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-2/12-11
Matrix Spike Duplicates	One per 20 samples	Percent recoveries and RPDs as per Worksheet #12-2/12-11	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Percent recoveries and RPDs as per Worksheet #12-2/12-11
LCS	One per 20 samples	Percent recoveries as per Worksheet #12-2/12-11	Determine cause of problem, re-extract, reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-2/12-11
Surrogates	Every sample extract and standard.	Percent recoveries as per Worksheet #12-2/12-11	Re-extract and reanalyze as and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-2/12-11

QAPP Worksheet #28-2

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	SVOCs					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-02					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Internal Standards (ISs)	Every sample extract and standard	Area counts: -50% ±100% of areas in associated continuing calibration standard Retention times: ± 30 seconds from retention times in associated continuing calibration standard	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Area counts: -50% ±100% of areas in associated continuing calibration standard Retention times: ± 30 seconds from retention times in associated continuing calibration standard

NA = Not Applicable TBD = To Be Determined

QAPP Worksheet #28-3

QC Samples Table

Matrix	Groundwater (Filtered and Unfiltered) / Soil					
Analytical Group	Metals					
Concentration Level	Groundwater (Filtered and Unfiltered) – Low Soil – Low					
Analytical Method/ SOP Reference	L-03					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	No target compounds ≥QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Reagent Blank**	One per 20 samples	No target compounds ≥ QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	One per 20 samples	RPD < 20 if results ≥ 5x QL	Qualify data	Analyst	Precision	RPD < 20 if results ≥ 5x QL
Matrix Spike	One per 20 samples	Percent recoveries 75-125%	Determine cause of problem, reanalyze, and/or qualify data	Analyst	Accuracy/bias	Percent recoveries 75-125%
Matrix Spike Duplicates	NA	NA	NA	NA	NA	NA
LCS	One per 20 samples	Percent recoveries 80-120%	Determine cause of problem, reanalyze, and/or qualify data	Analyst	Accuracy/bias	Percent recoveries 80-120%
Surrogates	NA	NA	NA	NA	NA	NA
Other: Serial Dilution	One per 20 samples	Within 10% of original determination	Qualify data	Analyst	Accuracy/bias	Within 10% of original determination
Other: QL Check Standard	Beginning and end of analytical sequence	Percent recoveries 70-130% (50-150% for manganese and zinc)	Recalibrate and reanalyze and/or qualify data	Analyst	Sensitivity and Accuracy/bias	Percent recoveries 70-130% (50-150% for manganese and zinc)
Other: Interference Check Sample	Beginning of run or every 8 hours	Percent recoveries 80-120%	Recalibrate and reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries 80-120%

** Also referred to as initial and continuing calibration blanks. NA = Not Applicable TBD = To Be Determined

QAPP Worksheet #28-4

QC Samples Table

Matrix	Groundwater (Filtered and Unfiltered)					
Analytical Group	Mercury					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-04					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	Prior to samples and one per 20 samples	Mercury < QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	Mercury < QL
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	One per 20 samples	RPD ≤ 20	Reanalyze and qualify data	Analyst	Precision	RPD ≤ 20
Matrix Spike	One per 20 samples	Percent recoveries 75-125%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 75-125%
Matrix Spike Duplicates	One per 20 samples	Percent recoveries 75-125%; RPD ≤ 20	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Percent recoveries 75-125%; RPD ≤ 20
LCS	One per 20 samples	Percent recoveries 80-120%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 80-120%
Surrogates	NA	NA	NA	NA	NA	NA

NA = Not Applicable
TBD = To Be Determined

QAPP Worksheet #28-5

QC Samples Table

Matrix	Groundwater (Filtered and Unfiltered)					
Analytical Group	Hexavalent Chromium					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-05					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	Hexavalent chromium < QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	Hexavalent chromium < QL
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	One per 20 samples	RPD ≤ 20	Reanalyze and qualify data	Analyst	Precision	RPD ≤ 20
Matrix Spike	One per 20 samples	Percent recoveries 85-115%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 85-115%
Matrix Spike Duplicates	NA	NA	NA	NA	NA	NA
LCS	One per 20 samples	Percent recoveries 90-110%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 90-110%
Surrogates	NA	NA	NA	NA	NA	NA
Other:						

NA = Not Applicable
TBD = To Be Determined

QAPP Worksheet #28-6

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	Cyanide					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-06					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	Cyanide < QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	Cyanide < QL
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	One per 20 samples	RPD ≤ 20	Reanalyze and qualify data	Analyst	Precision	RPD ≤ 20
Matrix Spike	One per 20 samples	Water: Percent recoveries 90-110% Soil: Percent recoveries 75-125%	Reanalyze and qualify data	Analyst	Accuracy/bias	Water: Percent recoveries 90-110% Soil: Percent recoveries 75-125%
Matrix Spike Duplicates	NA	NA	NA	NA	NA	NA
LCS	One per day in micro distillation unit Not in micro distillation unit – 3 per day	Percent recoveries 90-110%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 90-110%
Surrogates	NA	NA	NA	NA	NA	NA

NA = Not Applicable
TBD = To Be Determined

QAPP Worksheet #28-7

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	Pesticides					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-07					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	No target compounds ≥ QL	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst and Data Validator	Accuracy/bias-Contamination	No target compounds ≥ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	Following continuing calibration verification and as needed	No target compounds ≥ QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Matrix Spike	One per 20 samples	Percent recoveries as per Worksheet #12-7/12-16	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-7/12-16
Matrix Spike Duplicates	One per 20 samples	Percent recoveries and RPDs as per Worksheet #12-7/12-16	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Percent recoveries and RPDs as per Worksheet #12-7/12-16
LCS	One per 20 samples	Percent recoveries as per Worksheet #12-7/12-16	Determine cause of problem, re-extract, reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-7/12-16
Surrogates	1 per sample	Percent recoveries as per Worksheet #12-7/12-16	As specified in method and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-7/12-16
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA
Other: Endrin\DDT Breakdown	Every 12 hours	Percent breakdown < 15 for each compound	Perform injection port maintenance, retest, reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent breakdown < 15 for each compound

NA = Not Applicable TBD = To Be Determined

QAPP Worksheet #28-8

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	Herbicide: Silvex					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-08					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	No target compounds ≥ QL	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst and Data Validator	Accuracy/bias-Contamination	No target compounds ≥ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	After continuing calibration verification	No target compounds ≥ QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Matrix Spike	One per 20 samples	Percent recoveries as per Worksheet #12-8/12-17	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-8/12-17
Matrix Spike Duplicates	One per 20 samples	Percent recoveries and RPDs as per Worksheet #12-8/12-17	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Percent recoveries and RPDs as per Worksheet #12-8/12-17
LCS	One per 20 samples	Percent recoveries as per Worksheet #12-8/12-17	Determine cause of problem, re-extract, reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-8/12-17
Surrogates	2 per sample	Percent recoveries as per Worksheet #12-8/12-17	As specified in method and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-8/12-17
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

NA = Not Applicable TBD = To Be Determined

QAPP Worksheet #28-9

QC Samples Table

Matrix	Groundwater / Soil					
Analytical Group	PCB Aroclors					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-09					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	Soil: 15 Groundwater: 5					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per 20 samples	No target compounds ≥ QL	Reclean, retest, re-extract, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	Following continuing calibration verification	No target compounds ≥ QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	No target compounds ≥ QL
Laboratory Duplicate	NA	NA	NA	NA	NA	NA
Matrix Spike	One per 20 samples	Percent recoveries as per Worksheet #12-9/12-18	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-9/12-18
Matrix Spike Duplicates	One per 20 samples	Percent recoveries and RPDs as per Worksheet #12-9/12-18	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	Percent recoveries and RPDs as per Worksheet #12-9/12-18
LCS	One per 20 samples	Percent recoveries as per Worksheet #12-9/12-18	Determine cause of problem, re-extract, reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-9/12-18
Surrogates	2 per sample	Percent recoveries as per Worksheet #12-9/12-18	As specified in method and qualify data	Analyst	Accuracy/bias	Percent recoveries as per Worksheet #12-9/12-18
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

NA = Not Applicable
TBD = To Be Determined

QAPP Worksheet #28-10

QC Samples Table

Matrix	Soil					
Analytical Group	Mercury					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-10					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	Accutest Laboratories					
No. of Sample Locations	15					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	Prior to samples and one per 20 samples	Mercury < QL	Reclean, retest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	Mercury < QL
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	One per 20 samples	RPD $\leq$ 24	Reanalyze and qualify data	Analyst	Precision	RPD $\leq$ 24
Matrix Spike	One per 20 samples	Percent recoveries 75-125%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 75-125%
Matrix Spike Duplicates	One per 20 samples	Percent recoveries 75-125%; RPD $\leq$ 20	Reanalyze and qualify data	Analyst	Accuracy/bias and Precision	RPD $\leq$ 20
LCS	One per 20 samples	Percent recoveries 85-115%	Reanalyze and qualify data	Analyst	Accuracy/bias	Percent recoveries 85-115%
Surrogates	NA	NA	NA	NA	NA	NA

NA = Not Applicable
TBD = To Be Determined

QAPP Worksheet #28-11

QC Samples Table

Matrix	Soil					
Analytical Group	Hexavalent Chromium					
Concentration Level	Low					
Analytical Method/ SOP Reference	L-11					
Sampler's Name	TBD					
Field Sampling Organization	TRC					
Laboratory Name	TBD					
No. of Sample Locations	15					
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person(s) Responsible for CA**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	One per digestion batch or 20 samples, whichever is more frequent	Hexavalent Chromium < QL	Reclean, retest, re-digest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	Hexavalent Chromium < QL
Reagent Blank	Following continuing calibration verification	Hexavalent Chromium < QL	Reclean, retest, re-digest, reanalyze, and/or qualify data	Analyst	Accuracy/bias-Contamination	Hexavalent Chromium < QL
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Matrix Spike (soluble and insoluble)	One per digestion batch or 20 samples, whichever is more frequent	Percent recoveries 75-125%	Evaluate reducing properties of samples; reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries 75-125%
Matrix Spike Duplicates	NA	NA	NA	NA	NA	NA
LCS	One per digestion batch or 20 samples, whichever is more frequent	Percent recoveries 80-120%	Determine cause of problem, re-digest, reanalyze and/or qualify data	Analyst	Accuracy/bias	Percent recoveries 80-120%
Laboratory Duplicate	One per digestion batch or 20 samples, whichever is more frequent	RPD $\leq$ 20	Determine cause of problem, re-digest, reanalyze and/or qualify data	Analyst	Precision	RPD $\leq$ 20
Post Digestion Spike	One per digestion batch or 20 samples, whichever is more frequent	Percent recoveries 85-115%	Qualify data	Analyst	Accuracy/bias	Percent recoveries 85-115%

NA = Not Applicable
TBD = To Be Determined

QAPP Worksheet #29

Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
• Field Notes/Logbooks Chain-of-Custody Records • Field Forms • Photo-documentation • Corrective Action Forms	• Sample Receipt, Custody and Tracking Records • Equipment Calibration Logs, Equipment Maintenance, Testing and Inspection Logs, Sample Disposal Records, Field Activity Forms Telephone Logs • Field Screening Results, Corrective Action Forms	• Sample Receipt, Custody and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Preparation Logs • Run Logs • Equipment Maintenance, Testing and Inspection Logs • Corrective Action Forms • QC Sample Results Reports • Instrument Printout (raw data) for field samples, standards, QC checks and QC samples • Sample Disposal Records • Telephone Logs • Reported Field Sample Results • Extraction/Clean-up records • Raw Data (stored on CD)	• Field Sampling Audit Checklists (if applicable) • Fixed Lab Audit Checklist (if applicable) • Corrective Action Forms Telephone Logs • Data Validation Reports	

QAPP Worksheet #30

Analytical Services Table

Matrix	Analytical Group	Concentration Level	Analytical Method/SOP	Data Package Turnaround Time	Laboratory/Organization (Name and Address: Contact Person and Telephone Number)	Backup Laboratory/ Organization (Name and Address: Contact Person and Telephone Number)
Groundwater/ Soil	VOCs, SVOCs, Pesticides, Herbicide (Silvex), PCBs, Metals, Wet Chemistry[(1)]	Low	L-01 through L-11	14 days	Accutest Laboratories 2235 Route 130 Dayton, NJ 08810 Contact: Matt Cordova (732) 355-4550	None
Soil	Grain Size and Atterberg Limit Determinations	NA	ASTM D422 and ASTM D4318	21 days	TerraSense, LLP 45 H Commerce Way Totowa, NJ 07512 Contact: Greg Thomas (973) 812-1818	None

[(1)]Wet Chemistry includes cyanide and hexavalent chromium

QAPP Worksheet #31

Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings(Title and Organizational Affiliation)	Person (s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person (s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
None							

QAPP Worksheet #32

Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Acton Response (Name, Title, Org.)	Timeframe for Response
Field Sampling TSA	Written Audit Report	Field Team Manager and Project Manager, TRC	48 hours after audit	Letter	Elizabeth Denly/Project QA Officer, TRC	48 hours after notification
Fixed Laboratory TSA	Written Audit Report	Laboratory QA Manager	3 days after audit	Letter	Elizabeth Denly/Project QA Officer, TRC	1 week after notification

QAPP Worksheet #33

QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipients (Title and Organizational Affiliation)
Verbal Status Report	Daily	At the end of every day of field activities	Field Team Manager, TRC	Project Manager, TRC
Verbal or Written Status Report	As necessary	As necessary	Project Manager, TRC	Program Manager, TRC
Corrective Action Report	As necessary	As necessary	Project QA Officer, TRC	Project Manager, TRC
Final Project Report	Once/after sampling completed and data generated	4/1/2016	Project Manager and Program Manager, TRC	Kay Zias / Marty Rowland, NYCDPR

QAPP Worksheet #34

Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (Name, Organization)
Chains-of-Custody	Chain-of-Custody forms will be reviewed internally upon their completion and verified against the packed sample coolers for which they represent. When everything checks out, a copy of the chain-of-custody will be retained in the site file, and the original and remaining copies will be taped inside the cooler for shipment.	Internal	Field Team Manager, TRC
Field Notes	Field notes will be reviewed on a daily basis to ensure notes are accurate, all necessary calibration information has been documented, and notes are complete. Field notes will be placed in the site file and attached to the final report.	Internal	Field Team Manager, TRC
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the site file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the Field Team Manager will be notified to ensure action is taken.	Internal	Project Manager, TRC
Laboratory Data Packages	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Matt Cordova, Accutest
Laboratory Data Packages	Laboratory data packages may be verified according to the data validation procedures specified in Worksheet #36.	Internal	Elizabeth Denly, TRC
Data Validation Reports	All data validation reports will be technically reviewed for accuracy and completeness.	Internal	Elizabeth Denly, TRC
Final Report	All information provided in the final report will be verified against field documentation and results of data validation and will undergo TRC's Peer Review process.	Internal	Project Manager and Program Manager, TRC

QAPP Worksheet #35

Validation (Steps IIa and IIb) Process Table

StepIIa/IIb	Validation Input	Description	Responsibility for Data Validations (Name, Organizational affiliation)
IIb	On-site Analytical Work	All on-site analytical work will be reviewed against QAPP requirements for completeness and accuracy based on the field calibration records.	Field Team Manager, TRC
IIa	Sampling Procedures	Ensure that all sampling procedures in QAPP were followed	Field Team Manager, TRC
IIa	SOPs	Ensure that all analytical methods and SOPs were followed.	Elizabeth Denly, Project QA Officer, TRC
IIa	Documentation of Method QC Results	Establish that all method-required QC samples were run and met required limits.	Elizabeth Denly, Project QA Officer, TRC
IIb	Documentation of QAPP QC Sample Results	Establish that all QAPP-required QC samples were run and met required limits.	Elizabeth Denly, Project QA Officer, TRC
IIb	Project Quantitation Limits	Ensure that all sample results met the project quantitation limits specified in the QAPP.	Elizabeth Denly, Project QA Officer, TRC
IIa	Raw Data	Spot checks of raw data will be performed to confirm laboratory calculations.	Elizabeth Denly, Project QA Officer, TRC

QAPP Worksheet #36

Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (Name and Organizational Affiliation)
IIa	Groundwater	VOCs	Low	(1), (6)	Elizabeth Denly, TRC
IIb	Groundwater	VOCs	Low	Worksheets # 12-1, 15-1, 19, 20, 24 & 25, 28-1	Elizabeth Denly, TRC
IIa	Groundwater	SVOCs	Low	(2), (6)	Elizabeth Denly, TRC
IIb	Groundwater	SVOCs	Low	Worksheets # 12-2, 15-2, 19, 20, 24 & 25, 28-2	Elizabeth Denly, TRC
IIa	Groundwater	Metals (filtered and unfiltered)	Low	(5), (7)	Elizabeth Denly, TRC
IIb	Groundwater	Metals (filtered and unfiltered)	Low	Worksheets # 12-3, 15-3, 19, 20, 24 & 25, 28-3	Elizabeth Denly, TRC
IIa	Groundwater	Mercury (filtered and unfiltered)	Low	(7), (8)	Elizabeth Denly, TRC
IIb	Groundwater	Mercury (filtered and unfiltered)	Low	Worksheets # 12-4, 15-3, 19, 20, 24 & 25, 28-4	Elizabeth Denly, TRC
IIa	Groundwater	Hexavalent Chromium (filtered and unfiltered)	Low	(7)	Elizabeth Denly, TRC
IIb	Groundwater	Hexavalent Chromium (filtered and unfiltered)	Low	Worksheets # 12-5, 15-3, 19, 20, 24 & 25, 28-5	Elizabeth Denly, TRC
IIa	Groundwater	Cyanide	Low	(7), (8)	Elizabeth Denly, TRC
IIb	Groundwater	Cyanide	Low	Worksheets # 12-6, 15-4, 19, 20, 24 & 25, 28-6	Elizabeth Denly, TRC
IIa	Groundwater	Pesticides	Low	(3), (6)	Elizabeth Denly, TRC
IIb	Groundwater	Pesticides	Low	Worksheets # 12-7, 15-5, 19, 20, 24 & 25, 28-7	Elizabeth Denly, TRC
IIa	Groundwater	Herbicide – Silvex	Low	(3), (6)	Elizabeth Denly, TRC

Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (Name and Organizational Affiliation)
IIb	Groundwater	Herbicide – Silvex	Low	Worksheets # 12-8, 15-6, 19, 20, 24 & 25, 28-8	Elizabeth Denly, TRC
IIa	Groundwater	PCBs	Low	(4), (6)	Elizabeth Denly, TRC
IIb	Groundwater	PCBs	Low	Worksheets # 12-6, 15-7, 19, 20, 24 & 25, 28-9	Elizabeth Denly, TRC
IIa	Soil	VOCs	Low	(1), (6)	Elizabeth Denly, TRC
IIb	Soil	VOCs	Low	Worksheets # 12-10, 15-8, 20, 19, 24 & 25, 28-1	Elizabeth Denly, TRC
IIa	Soil	SVOCs	Low	(2), (6)	Elizabeth Denly, TRC
IIb	Soil	SVOCs	Low	Worksheets # 12-11, 15-9, 19, 20, 24 & 25, 28-2	Elizabeth Denly, TRC
IIa	Soil	Metals	Medium	(5), (7)	Elizabeth Denly, TRC
IIb	Soil	Metals	Medium	Worksheets # 12-12, 15-10, 19, 20, 24 & 25, 28-3	Elizabeth Denly, TRC
IIa	Soil	Mercury	Low	(7), (8)	Elizabeth Denly, TRC
IIb	Soil	Mercury	Low	Worksheets # 12-13, 15-10, 19, 20, 24 & 25, 28-10	Elizabeth Denly, TRC
IIa	Soil	Hexavalent Chromium	Low	(7)	Elizabeth Denly, TRC
IIb	Soil	Hexavalent Chromium	Low	Worksheets # 12-14, 15-10, 19, 20, 24 & 25, 28-11	Elizabeth Denly, TRC
IIa	Soil	Cyanide	Low	(7), (8)	Elizabeth Denly, TRC
IIb	Soil	Cyanide	Low	Worksheets # 12-15, 15-11, 19, 20, 24 & 25, 28-6	Elizabeth Denly, TRC
IIa	Soil	Pesticides	Low	(3), (6)	Elizabeth Denly, TRC
IIb	Soil	Pesticides	Low	Worksheets # 12-16, 15-12, 19, 20, 24 & 25, 28-7	Elizabeth Denly, TRC
IIa	Soil	Herbicide – Silvex	Low	(3), (6)	Elizabeth Denly, TRC
IIb	Soil	Herbicide – Silvex	Low	Worksheets # 12-17, 15-13, 19, 20, 24 & 25, 28-8	Elizabeth Denly, TRC

Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (Name and Organizational Affiliation)
IIa	Soil	PCBs	Low	(4), (6)	Elizabeth Denly, TRC
IIb	Soil	PCBs	Low	Worksheets # 12-18, 15-14, 19, 20, 24 & 25, 28-9	Elizabeth Denly, TRC

NA – Not Applicable; data validation not being performed on groundwater sample data
(1) - Validating Volatile Organic Compounds by SW-846 Method 8260B, HW-24, Revision 2, October 2006, Region 2.
(2) - Validating Semivolatile Organic Compounds by SW-846 Method 8270, HW-22, Revision 3, October 2006, Region 2.
(3) - Data Validation SOP of Organochlorine Pesticides by Gas Chromatography SW-846 Method 8081B, HW-44, Revision 1, October 2006, Region 2.
(4) - Data Validation SOP of Organic Analysis of PCBs by Gas Chromatography SW-846 Method 8082A, HW-45, Revision 1, October 2006, Region 2.
(5) - ICP-AES Data Validation, HW-2A, Revision 15, December 2012, Region 2.
(6) - National Functional Guidelines for Superfund Organic Methods Data Review, EPA-540/R-014-002, August 2014.
(7) - National Functional Guidelines for Inorganic Superfund Data Review, EPA 540-R-013-001, August 2014.
(8)- Mercury and Cyanide Data Validation, HW-2C, Revision1 5, December 2012, Region 2.

QAPP Worksheet #37

Usability Assessment

Data Usability

The purpose of this section is to indicate the methods by which it will be ensured that the project quality objectives are met. The data usability assessment will be performed by the TRC Project Manager, in conjunction with the TRC Project QA Officer.

Precision

The RPD between the matrix spike and matrix spike duplicate in the case of organic parameters, or sample and sample duplicate in the case of all parameters, is calculated to compare to precision objectives. Two (2) MS/MSDs and two (2) blind laboratory duplicates will be used to assess analytical precision and the field duplicates will be used to assess project precision. The RPD will be calculated according to the following formula:

$$RPD = \frac{(Amount\ in\ Sample\ 1 - Amount\ in\ Sample\ 2)}{0.5\ (Amount\ in\ Sample\ 1 + Amount\ in\ Sample\ 2)} x\ 100$$

The impact of analytical imprecision, project imprecision, and overall imprecision (when both analytical and project precision tests show problems) on data usability will be assessed. If the precision results yield data which are not usable, the data usability assessment will identify how this problem will be resolved and the potential need for resampling will be discussed in the final project report.

Accuracy

If field or laboratory contamination exists, the impact on the data will be evaluated during the data usability assessment. The direction of bias for contamination will be identified.

In order to assure the accuracy of the analytical procedures, two (2) matrix spike samples will be utilized. The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample, determines percent recovery (%R).

QAPP Worksheet #37

Usability Assessment

Accuracy is similarly assessed by determining %Rs for surrogate compounds added to each field and QC sample to be analyzed for organic parameters. Accuracy for all analyses will be further assessed through determination of %Rs for LCSs and calibration results, etc. If the Data Validation Reports indicate contamination and/or analytical biases, the impact on the data will be assessed.

%R for MS/MSD results will be determined according to the following equation:

$$\%R = \frac{(Amount\ in\ Spiked\ Sample - Amount\ in\ Sample)}{Known\ Amount\ Added} x\,100$$

%R for LCSs and surrogate compound results will be determined according to the following equation:

$$\%R = \frac{Experimental\ Concentration}{Known\ Amount\ Added} x\,100$$

Overall contamination and accuracy/bias will be reviewed for each matrix and analytical parameter. The data usability assessment will include any limitations on the use of the data, if it is limited to a particular matrix, data package, parameter, or laboratory. If the accuracy results yield data which are not usable, the data usability assessment will identify how this problem will be resolved and the potential need for resampling will be discussed in the final project report.

Representativeness

If the two (2) field duplicates indicate spatial variability, the data usability assessment will evaluate the impact on the data. Overall sample representativeness will be evaluated for each matrix (soil and groundwater) and analytical parameter. The data usability assessment will include any limitations on the use of the data, if limited to a particular matrix, data package, parameter, or laboratory. If the results of the evaluation of representativeness yield data which are not usable, the data usability assessment will identify how this problem will be resolved and the potential need for resampling will be discussed in the final project report.

Sensitivity and Quantitation Limits
Overall sensitivity will be reviewed for each matrix and analytical parameter. The impact on the lack of sensitivity or the reporting of higher quantitation limits by the laboratory will be assessed. The data usability assessment will include any limitations on the use of the data, if limited to a particular matrix, data package, parameter, or laboratory. If the results of the evaluation of sensitivity yield data which are not usable, the data

QAPP Worksheet #37

Usability Assessment

usability assessment will identify how this problem will be resolved and the potential need for resampling will be discussed in the final project report.

Completeness

Completeness is the ratio of the number of valid sample results to the total number of samples analyzed or processed. Following completion of the testing, the percent completeness will be calculated by the following equation:

$$Completeness = \frac{(number\ of\ valid\ measurements)}{(number\ of\ measurements\ planned)} x\,100$$

Overall completeness will be reviewed for each matrix and analytical parameter. The data usability assessment will include any limitations on the use of the data, if limited to a particular matrix, data package, parameter, or laboratory. If the results of the evaluation of completeness yield data which are not usable, the data usability assessment will identify how this problem will be resolved and the potential need for resampling will be discussed in the final project report.

Data Limitations and Actions

The field and laboratory data collected during this investigation will be used to achieve the objectives identified in Sections 6.0 and 8.0 of this QAPP. The QC results associated with each analytical parameter for each matrix will be compared to the objectives presented in this QAPP. Data generated in association with QC results meeting the stated acceptance criteria (i.e., data determined to be valid) will be considered usable for decision-making purposes. Limitations on the use of the data will be stated and explained, if necessary.

In addition, the data obtained will be both qualitatively and quantitatively assessed on a project-wide, matrix-specific, and parameter-specific basis. Results of the measurement error assessments will be applied against the site as a whole; any conclusions will be documented in the final report. Data generated in association with QC results not meeting the stated acceptance criteria may still be considered usable for decision-making purposes, depending on certain factors. This assessment will be performed by the TRC Project Manager, in conjunction with the TRC Project QA Officer, and the results presented and discussed in detail in the final report. Factors to be considered in this assessment of field and laboratory data will include, but not necessarily be limited to, the following.

- Conformance to the field methodologies and procedures proposed in the QAPP,

QAPP Worksheet #37

Usability Assessment

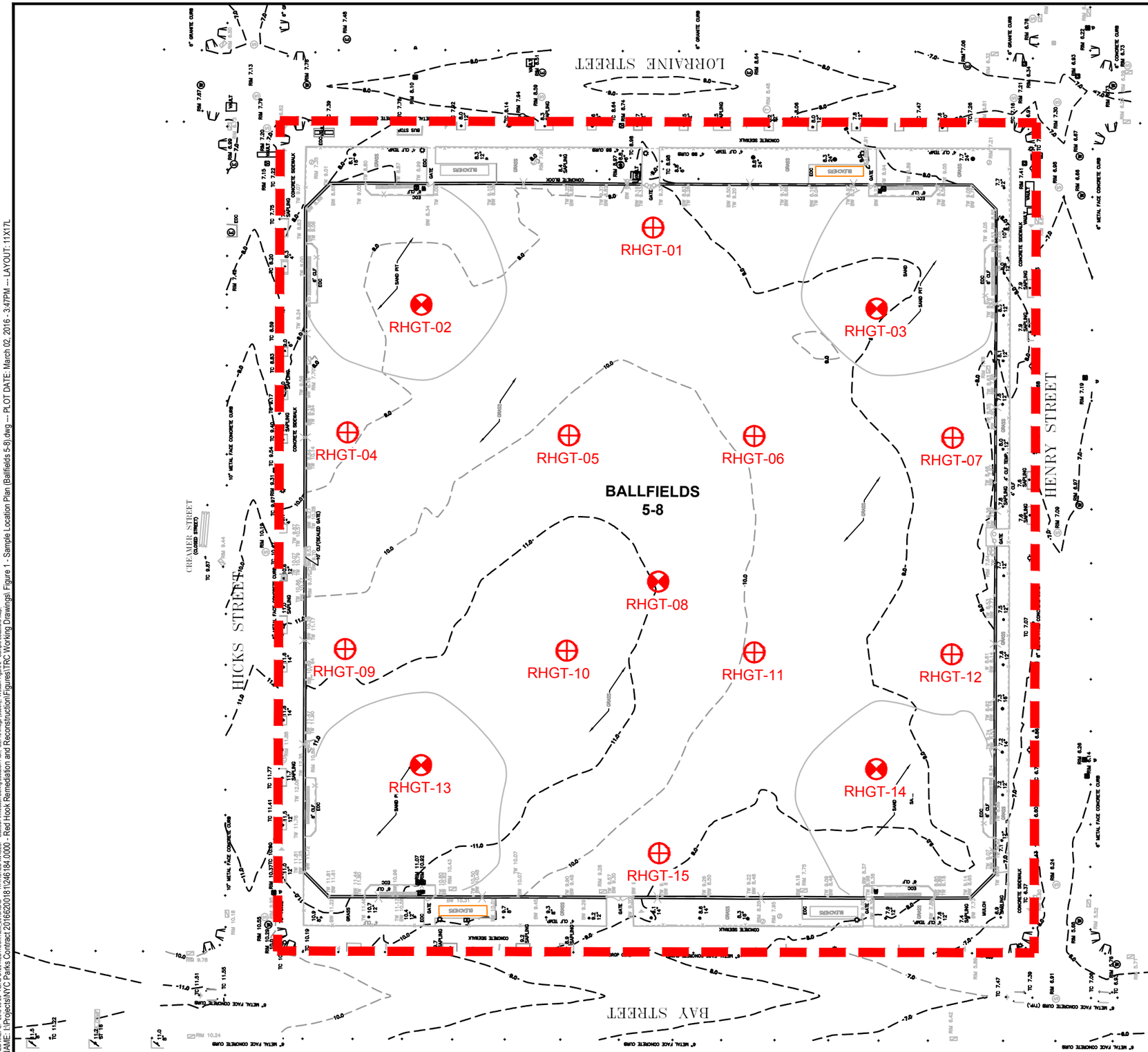
- Conformance to the EPA methods and laboratory SOPs cited in the QAPP,
- Adherence to proposed sampling strategy,
- Presence of elevated detection limits due to matrix interferences or contaminants present at high concentrations,
- Presence of analytes not expected to be present,
- Status of all issues requiring corrective action, as presented in the QA reports to management,
- Effect of nonconformance (procedures or requirements) on project objectives,
- Adequacy of the data as a whole in meeting the project objectives, and
- Identification of any remaining data gaps and need to reevaluate data needs.

Every attempt will be made to eliminate any sources of sampling and analytical error as early as possible in the program. An ongoing data assessment program throughout the program will also assist in the early detection and correction of problems, thereby ensuring that project objectives are met.

Reconciliation with the project objectives will have been considered to have been met if the measurement performance criteria from Worksheet #12 are met. If the data usability indicates that the project quality objectives in Worksheet #11 have not been met, then the project management team will meet to determine if additional work needs to be performed.

ATTACHMENT 1

SAMPLE LOCATION PLAN



LEGEND (SYMBOLS NOT TO SCALE):

- PROJECT SCOPE
- RHGT-XX — GEOTECHNICAL BORING LOCATION AND IDENTIFICATION NUMBER
- RHGT-XX — PERMEABILITY TEST AND GEOTECHNICAL BORING LOCATION AND IDENTIFICATION NUMBER

NOTES:

1. SURVEYED BY THE CITY OF NEW YORK - PARKS AND RECREATION DATED 3/19/15.
2. ELEVATIONS SHOWN HERON REFER TO THE NORTH AMERICAN VERTICAL DATUM (NAVD88)
3. SUBSURFACE UTILITY INFORMATION TAKEN FROM VARIOUS CITY MAPS AND PRIVATE UTILITY COMPANIES.
4. THE LOCATION OF UNDERGROUND UTILITIES AS SHOWN HEREON ARE BASED ON ABOVE GROUND STRUCTURES, PARKS RECORD DRAWINGS AND CITY RECORD MAPS. LOCATION OF UNDERGROUND UTILITY / STRUCTURES MAY VARY FROM LOCATIONS SHOWN HEREON. ADDITIONAL BURIED UTILITIES / STRUCTURES MAY BE ENCOUNTERED. NO EXCAVATION WAS MADE DURING THE PROGRESS OF THIS SURVEY TO LOCATE BURIED UTILITIES. BEFORE COMMENCING EXCAVATION, CONTRACTORS SHOULD CALL 1-800-272-4480 CODE RULE 53

0 60' 120'

SCALE: 1" = 60'
SHEET SIZE: 11"X17"

PROJECT:
CITY OF NEW YORK PARKS AND RECREATION - CAPITAL PROJECTS DIVISION
RED HOOK PARK: BALLFIELDS 5, 6, 7 AND 8
BOROUGH OF BROOKLYN, NEW YORK

TITLE:
SAMPLE LOCATION PLAN

DRAWN BY:	HD	PROJ NO.:	246184.0000.0000
CHECKED BY:	WL		**FIGURE 1**
APPROVED BY:	JM		
DATE:	MARCH 2016		

TRC
1430 Broadway
10th Floor
New York, NY 10018
Phone: 212.221.7822

FILE NO.: Figure 1 - Sample Location Plan (Ballfields 5-8).dwg

ATTACHMENT 2

TRC RESUMES

JENNIFER L. MIRANDA

EDUCATION

M.S., Environmental and Occupational Health Science, Hunter College, 2002
National Institute of Environmental and Occupational Health Fellow 2002
B.S., Anthropology/ Biology, Human and Natural Ecology, Emory University, 1998

PROFESSIONAL REGISTRATION/CERTIFICATIONS

Certified Asbestos Inspector, New York State Department of Labor

AREAS OF EXPERTISE

Ms. Jennifer Miranda has over 15 years of experience and has assumed progressively increasing responsibility in environmental consulting and remedial construction management. Ms. Miranda serves as Senior Project Manager in TRC's New York office, in the Remediation Practice. Her qualifications include extensive planning, field investigation, work plan and report preparation, cost estimating, remedial construction management and project management. Ms. Miranda has served in the capacity of project manager for a number of large, complex and diverse environmental projects in New York City.

Ms. Miranda has project management and technical experience in the following areas:

- Remedial Investigation
- Remedial Construction Oversight
- Decommissioning/Demolition Services
- Pre-Demolition Hazardous Building Materials Surveys
- Environmental Assessments and Audits
- Environmental Health and Safety
- Environmental Compliance

REPRESENTATIVE EXPERIENCE

Queens West Development – Stage 2 Site – Long Island City, NY

Ms. Miranda served as the Project Manager for the over $60 million remediation of the Queens West Development – Stage 2 Site, the site of a former oil refinery in Long Island City. In addition to the several historic abandoned underground storage tank systems, buried on the site was an extensive network of historic refinery piping. The Site was contaminated with petroleum-related VOCs and SVOCs, and metals, in several instances present in soil at concentrations above TCLP regulatory limits, and a large LNAPL plume. In connection with Operable Units 3 and 4 (OUs 3 and 4) (NYSDEC BCP Site Nos. C241095 and C241096), which consist of over 9 acres adjacent to the East River, since developed for primarily residential/public recreational use (including a waterfront park), Ms. Miranda was responsible for the preparation of the Remedial Investigation (RI) Work Plan, RI Report, Remedial Action Work Plan, Final Engineering Reports and Site Management Plans as well as Odor and Vapor Control and Enhanced Community Air Monitoring Plans. Ms. Miranda was also responsible for supervising

implementation of the work plans. The RI included advancement and sampling of hundreds of soil borings, installation and sampling of an extensive monitoring well network, soil gas sampling within the footprints of the planned buildings, sediment and surface water sampling in the East River to determine potential site impacts, locating and characterizing buried historic refinery remnants, a tidal influence study, a human health risk assessment and fish and wildlife impact analysis. Implementation of the remedial action work plan, supervised by Ms. Miranda, included high vacuum extraction of thousands of gallons of LNAPL, pre-excavation waste characterization and re-use sampling (over 250 borings and thousands of samples were collected for analysis), excavation of over 100,000 tons of contaminated soil under negative pressure enclosures (i.e., tents) and off-site disposal of excavated material, and post-remediation soil, groundwater and soil gas sampling. Ms. Miranda was responsible for financial management, investigation and construction phase field coordination and management, health and safety program management, daily and monthly reporting to the NYSDEC, community outreach program implementation and subcontractor procurement and management. Ms. Miranda served as a primary point of contact for nearby residents during the site remediation, presented at public meetings, prepared fact sheets for distribution to the public, and served as a primary point of contact with the NYSDEC and NYSDOH in connection with responding to local citizens' concerns. In addition, Ms. Miranda managed implementation of a chemical oxidation pilot test on the site, including preparation of a NYSDEC-approved pilot test work plan. In December 2010 NYSDEC issued the final Certificates of Completion for Operable Units 3 and 4 under the BCP.

New York City Economic Development Corporation – On-Call Environmental Consulting Services Contract – New York, NY

Ms. Miranda co-manages TRC's on-call environmental services contract with the New York City Economic Development Corporation (NYCEDC). Under Ms. Miranda's management, TRC has provided the following services to the NYCEDC: supplemental investigation work plans; lead investigation and dust removal; remedial oversight and management of a PCB release; asbestos surveys; in-situ soil characterization and specifications for reuse and disposal; semi-annual groundwater monitoring; annual inspections and periodic review reporting for NYSDEC VCP Site V00228, St. George Ball Park, Staten Island; remedial oversight and preparation of the site management plan and final engineering report for NYSDEC Environmental Restoration Site B000312, Bush Terminal Landfill Piers 1-4, Brooklyn; and indoor air quality monitoring and microbial sampling.

Under previous on-call contracts, Ms. Miranda managed several environmental site assessments and site investigations for NYCEDC. Ms. Miranda managed the large-scale Island-wide investigation of Governors Island in Upper New York Bay. Governors Island is the site of historic military and US Coast Guard operations.

Engineering Services during Decommissioning: Charles Poletti Power Plant – Astoria, NY

Ms. Miranda serves as the Project Manager for engineering during decommissioning of the Charles Poletti Power Plant. The Charles Poletti Power

Plant was a steam-electric 885 megawatt facility capable of firing natural gas and fuel oil. NYPA ceased operations at Poletti in January 2010. In June 2010, TRC was contracted to provide engineering services for the decommissioning of the Charles Poletti Power Plant. Decommissioning services provided to NYPA by TRC under Ms. Miranda's management have included an asbestos/regulated materials survey; coordination and oversight of asset recovery; pre-demolition structural assessment of adjoining buildings and cooling water intake and discharge structures; preparation of specifications and drawings for abatement, decommissioning, and demolition; and, preparation of an engineer's cost estimate and bid documents. In addition, Ms. Miranda managed bid phase services for the decommissioning and demolition project. Ms. Miranda also managed design services for temporary winterization of the Poletti Plant and for the relocation of electrical connections and procurement of a New Electric Fire Water Pump System. Ms. Miranda has served as the project manager during the construction phase including the following services: engineer of record, asbestos-abatement project monitoring and environmental and health and safety inspection services.

Ms. Miranda served as the project manager for characterization of sediment in support of upland disposal of material dredged from the former cooling water discharge canal as part of the decommissioning. The decommissioning activities include the removal of the sheet pile wall which forms the Cooling Water Discharge Canal in the East River. Excess sediment deposits within the Cooling Water Discharge Canal will be dredged in accordance with the Joint Application for Permit to the NYSDEC and the US Army Corps of Engineers (USACE). Ms. Miranda managed the preparation and implemented of a Field Sampling Plan (FSP) to characterize the material to be dredged for upland disposal. The FSP was prepared to meet the requirements of the NYSDEC Dredge Team and the New Jersey Department of Environmental Protection (NJDEP) Office of Dredging & Sediment Technology. Because of the limited boat access, a vibracore operator and crane were subcontracted to obtain the sediment samples from land. Global positioning system (GPS) readings were taken at the sample locations. A Sediment Sampling and Analysis Report was prepared for joint approval from the NYSDEC and NJDEP. Ms. Miranda is working with sediment disposal outlets in the region to gain acceptance of the material via barge for stabilization and ultimately upland disposal.

New York City School Construction Authority – New York, NY
Under TRC's on-call hazardous materials services contract with the New York City School Construction Authority, Ms. Miranda has served as project manager for several assignments. Responsibilities have included supervising the preparation of Phase I Environmental Site Assessment reports, preparation of a subsurface investigation summary report for a site with an active spill case, management of the preparation of Phase II Environmental Site Assessment reports, and focused regulatory agency database and prior report reviews for leased properties (over 50 leased New York City public school properties).

Stewart EFI Facility - VCP Site No. V00691, Yonkers, NY
Ms. Miranda served as Project Manager for the regulatory closure of a former

100,000-square foot metal stamping and electroplating facility site in Yonkers, New York (NYSDEC VCP Site No. V00691). Ms. Miranda served as the primary contact with the NYSDEC Project Manager and managed the implementation of the Supplemental Investigation and preparation of the Remedial Investigation and Remedial Alternatives Report, and the Site Management Plan. A release and covenant not to sue letter was issued by the NYSDEC for the site in October 2011.

Sequa – Former Chromalloy Facility – State Superfund Site No. 344039, West Nyack, NY
Ms. Miranda serves as Project Manager for the regulatory closure of the former metal coating facility in West Nyack, New York. The Site is undergoing remediation under the New York State (NYS) Inactive Hazardous Waste Disposal Site Remedial Program, administered by New York State Department of Environmental Conservation (NYSDEC). Ms. Miranda serves as the primary contact with the NYSDEC Project Manager and managed the preparation of the Interim Site Management Plan. Maintenance and monitoring of an existing remediation system is ongoing.

Spectra Energy – Natural Gas Pipeline Project, Linden, NJ to New York, NY
Ms. Miranda served as Manager for the construction dewatering permitting in Staten Island and Manhattan in support of the installation of the new natural gas pipeline. Ms. Miranda prepared permit applications which included treatment of dewatering fluids and discharge at ten temporary outfalls to wetlands and surface water bodies, obtained necessary permits and approvals, and administered the preparation of reports and termination of construction dewatering permits.

The Port Authority of NY & NJ, Port Ivory Voluntary Cleanup Program Sites - VCP Site Nos. V00615, V00674, and V00675, Staten Island, NY
Ms. Miranda assessed the regulatory status of three VCP Sites. The three Sites encompass approximately 123-acres in the Port Ivory area of Staten Island, New York. Ms. Miranda performed a file review, site visit and prepared summaries and flow charts for presentation to the NYSDEC case manager. Ms. Miranda presented the strategy at a meeting with the NYSDEC to achieve site closure/release and covenant not to sue for each Site. NYSDEC has approved closure of two of the sites under the VCP and the Remedial Action Work Plan for the third site is under review by the NYSDEC.

SPECIALIZED TRAINING

- OSHA 40-Hour Hazardous Waste Operations and Emergency Response
- OSHA 8-Hour Hazardous Waste Operations and Emergency Response Refresher
- OSHA 8-Hour Supervisor of Hazardous Waste Operations
- NYC Mayor's Office of Environmental Remediation (OER) Turbo-Training Gold Certified 2014
- Practical Applications in Hydrogeology, Rutgers University
- EPA's All Appropriate Inquiry Rule, National Brownfields Association
- USEPA Region 4 Standard Operating Procedures for Field Sampling
- Hazard Ranking System Training Course

WES LINDEMUTH, CHMM, CSP

EDUCATION

B.S., Environmental Science, Kutztown University, December 2004

PROFESSIONAL REGISTRATION/CERTIFICATIONS

IHMM – Certified Hazardous Materials Manager – CHMM (No. 15661), May 2011
BCSP – Certified Safety Professional – CSP (No. CSP-30429), September 2015
NYSDEC – Erosion and Sediment Control Training (No. 45T-012014-31), January 2014

AREAS OF EXPERTISE

Mr. Lindemuth has experience in the following general areas:

- Project Management
- Environmental Assessment and Audit
- Remedial Investigation
- Remedial Construction Inspection and Management
- Underground Storage Tank Investigation and Management
- Environmental Health and Safety
- Hazardous Materials Building Inspections
- Indoor Air Quality Investigations
- Vapor Intrusion Assessments

Mr. Wes Lindemuth serves as a Senior Project Manager based in TRC's New York City office and has approximately 11 years of experience and has assumed progressively increasing responsibilities in environmental consulting. His experience includes project scoping, budgeting, management, implementation of site assessments and investigations, reporting, health and safety management and close out of large scale environmental projects as well as supervising and directing project staff. Mr. Lindemuth has performed, reviewed and managed staff in connection with over 500 Phase I Environmental Site Assessments (ESAs) and 40 Phase II Environmental Site Investigations (ESIs) for residential, commercial, industrial, manufacturing and other properties throughout his career.

REPRESENTATIVE EXPERIENCE

ProSource Technologies LLC – NYS Smart Home Buyout Program

Mr. Lindemuth served as a Project Manager providing consulting services in connection with pre-acquisition due diligence for Hurricane Sandy-impacted residential and commercial properties located throughout New York. Responsibilities included the management of the completion of nearly 400 Phase I ESAs, 1,045 Tier II Forms, 12 Phase II ESIs and implementation of Stormwater Pollution Prevention Plan (SWPPP) inspections. Responsibilities also included all aspects of scope of work and cost estimate preparation, attending client meetings, staff supervision, subcontractor supervision, work plan implementation, and report preparation.

NYC School Construction Authority – New York City, NY

Mr. Lindemuth served as a Project Manager providing consulting services in connection with proposed new construction, alteration, and leased sites to assess the suitability of the sites for use as public school facilities. Responsibilities included management of 25 Phase I ESAs, 15 Phase II ESIs, five Vapor Intrusion and Indoor Air Quality Investigations, three underground storage tank (UST) Closures, four petroleum spill investigations, four Product Safety reviews, review of two excavated material disposal plans (EMDPs), preparation of state pollutant discharge elimination system (SPDES) permit applications, Long Island well permit applications, a chemical bulk storage tank closure plan, and assisted with obtaining New York City (NYC) Department of Environmental Protection (DEP) sewer use permits. Responsibilities included all aspects of scope of work and cost estimate preparation, client consultation, staff supervision, subcontractor supervision and work plan implementation, emergency response, and report writing including development of conclusions and recommendations.

NYC Economic Development Corporation – NY

Mr. Lindemuth served as an Assistant Project Manager in connection with seven Phase I ESAs, four Phase II ESIs, one hazardous material building inspection, an UST closure and two in-situ soil characterizations. Responsibilities included all aspects of preparation of Phase I ESA reports, all elements of Phase II ESI field investigations, confined space entry associated with the inspection of an underground storage tank vault, and preparation of two winning proposals for in-situ soil characterization. Additionally, responsible for the field inspection services in connection with the initial preparation of the Bush Terminal Landfill for development into a park. Responsibilities included inspection of dynamic compaction activities on the landfill, storm water management, soil gas sampling, and installation of groundwater monitoring well network.

Brookfield Office Properties – Manhattan West, New York, NY

Mr. Lindemuth served as a Project Manager responsible for managing the performance of environmental services in connection with the construction of a 69-story commercial tower at the Manhattan West redevelopment project enrolled in the New York City Office of Environmental Remediation (OER) Voluntary Cleanup Program (VCP). Services included interface with the OER and coordination from enrollment through completion of the VCP, performance of a soil vapor investigation, preparation of a Hazardous Materials Remedial Action Work Plan (RAWP), a Noise Remedial Action Plan (RAP) and an Air Quality RAP required as part of the VCP. Environmental services also included remediation oversight in connection with the performance of soil characterization sampling and excavation and off-site disposal of historic fill and hazardous waste. In addition, responsibilities included the management of a third party monitoring consultant in connection with the performance of lead abatement activities of the Dyer Avenue Bridge including interface with Port Authority and review of the abatement contractor lead compliance program and health and safety plan (HASP). The Site received a Notice to Proceed from OER in May 2015.

Vornado Realty Trust – New York City

Mr. Lindemuth served as Project Manager responsible for the continuous performance of due diligence and environmental investigation services associated with acquisition, financial lending and redevelopment of over 25 properties located in NYC. Responsible for managing the performance of property inspections, remediation cost estimates, Phase I ESAs, Phase II ESIs

and coordination with NYC OER in connection with Site redevelopment including Site investigations, preparation of Remedial Action Work Plans, and Remedial Action Reports.

Two Trees Management Company – 60 Water Street, Brooklyn, NY

Mr. Lindemuth served as a Project Manager responsible for the implementation of a Remedial Action Work Plan in connection with the redevelopment of the 46,000-square-foot NYC OER VCP site. Responsibilities included staff supervision during the oversight of the excavation and off-site disposal of approximately 33,000-cubic yards of historic fill and soil from the site, daily reporting to the NYC OER, collection of post-excavation end-point soil samples, oversight of the removal of underground storage tanks, performance of inspections in connection with the installation of a passive sub-slab venting system, and preparation of a Remedial Action Report. The site received a notice of satisfaction from OER in December 2014.

Two Trees Management Company – Domino Sugar Project, Brooklyn, NY

Mr. Lindemuth served as a Project Manager providing consulting services in connection with the large scale, mixed-use development project to redevelop the 11.1 acre plot of land the former Domino Sugar Refinery currently resides on. Responsibilities included managing the development of several construction measure plans including dust control, noise control, soil erosion and sediment control, pest management, and air emission reduction measures. Responsible for implementing a groundwater monitoring program to comply with the NYSDEC regulations in connection with two 250,000-gallon No. 6 fuel oil underground storage tanks. In addition, managed and supervised staff during the performance of weekly inspections and submission of a monthly compliance report to the NYC Department of City Planning.

SL Green Realty Corporation – Due Diligence, New York City

Mr. Lindemuth served as a Project Manager responsible for the performance of due diligence and environmental investigation services associated with acquisition, financial lending and redevelopment of over 25 properties located in NYC. Services provided include performance of property inspections, remediation cost estimates, Phase I ESAs, Phase II ESIs and one property enrolled in the New York State Brownfield Cleanup Program.

BCRE – New York City

Mr. Lindemuth served as Project Manager responsible for managing the performance of OER related services associated with the redevelopment of two properties in NYC. Responsibilities included all aspects of the required coordination with OER including staff supervision during the preparation of Notices of No Objection, Site Investigation Work Plans, performance of Site Investigations, preparation of Site Investigation Reports and Remedial Action Work Plans.

Artimus - 310 West 118th Street, Harlem, NY

Mr. Lindemuth served as a Project Manager responsible for closure of a NYSDEC spill case and satisfaction of the OER reporting in connection with the redevelopment of an E-Designation site which involved the removal of two underground storage tanks, excavation and off-site disposal of petroleum contaminated soil and historic fill, inspection of the installation of a vapor barrier, and preparation and approval of a OER Remedial Closure Report.

HINES – 1 Vanderbilt, New York, NY

Mr. Lindemuth served as a Project Manager responsible for managing the performance of environmental services associated with the demolition of four buildings located adjacent to and west of Grand Central Station to allow construction of a 64-story commercial building. Responsibilities included supervising staff during the performance of a Site Investigation and associated reporting to the NYC DEP and OER.

Gardiner and Theobald – Brooklyn Botanical Garden, Brooklyn, NY

Mr. Lindemuth served as a Project Manager responsible for providing environmental consulting services in connection with the implementation of enhancements at the Brooklyn Botanical Garden. Responsible for implementation of a soil investigation program and reporting associated with the NYC DEP City Environmental Quality Review (CEQR) review process. Prepared a Construction Health and Safety Plan for use in connection with construction activities.

Breeze Demolition Inc. – JFK Airport, Queens, NY

Mr. Lindemuth served as a Project Manager responsible for managing the preparation of work plans associated with the demolition of Hangers 3, 4 and 5 located at the JFK Airport. Responsibilities included preparation of a Fire Safety Plan, Dewatering Plan and Soil Erosion and Sediment Control Plan for submittal for review and approval by the Port Authority.

New York Families for Autistic Children – Queens, NY

Mr. Lindemuth served as an Associate Project Manager providing environmental consulting services to the New York Families for Autistic Children (NYFAC) in connection with acquisition of a CEQR property located in Queens, New York. Services included the review of prior reports and regulatory correspondence (e.g., conditional negative declaration), performance of an Indoor Air Quality Survey, cleanout of two drywells, and a vapor intrusion survey. Responsibilities included all client coordination, proposal preparation, report preparation, and invoicing.

Spectra Energy – NY/NJ Expansion

Mr. Lindemuth served as an Associate Project Manager in connection with the construction of a natural gas pipeline from New Jersey to New York. The project consisted of the construction of approximately 20.3 miles of multi-diameter pipeline, associated pipeline support facilities, and six new metering and regulating stations. Mr. Lindemuth supervised a team of ten environmental inspectors performing oversight of construction activities including excavation and off-site disposal of non-hazardous and hazardous soil, treatment of groundwater prior to discharge to the ground surface or surface water body, spill reporting and cleanup, stormwater erosion and control inspection, worker health and safety oversight, and compliance with the Federal Energy Regulation Commission (FERC)-approved work plans. Responsibilities included team supervision, team health and safety oversight, review and distribution of daily reports, soil disposal management and tracking, and responding to client requests associated with construction operations.

Turner Construction Company – MSK/CUNY Project, New York, NY

Mr. Lindemuth served as a Project Manager responsible for providing environmental risk management in connection with the redevelopment of a former department of sanitation property

into a Memorial Sloan Kettering Cancer Center and City University of New York Campus. Responsibilities included subcontractor submittal review, staff supervision during soil and bedrock excavation oversight, manifest and hauler tracking, UST removal oversight, air and noise monitoring, and health and safety oversight.

DHL Express USA – Due Diligence, Texas

Mr. Lindemuth served as a Project Manager in connection with the performance of due diligence activities associated with the evaluation of several commercial properties located in Texas. Responsibilities included managing and supervising staff during the performance of Phase I ESAs and preparation of recommendations in connection with potential environmental risk.

AIMCO, West Harlem Portfolio – Manhattan, NY

Mr. Lindemuth served as a Senior Project Scientist responsible for performing pre-acquisition due diligence surveys for 95 apartment buildings located throughout the Harlem neighborhood in Manhattan, New York for AIMCO, a real estate investment trust company. Responsibilities included preparation of Phase I ESA reports for each property as well as radon sampling and implementing several Phase II ESIs. Performed construction oversight for remediation projects including oversight of the removal of an underground storage tank system and oversight of in-situ chemical oxidation for groundwater remediation for AIMCO.

GDF SUEZ, Astoria Energy Power Plant – Queens, NY

Mr. Lindemuth served as an Article X Environmental Inspector working on behalf of Suez Energy (owner) in connection with the construction phase of a state-of-the-art Power Generating Facility in Astoria, NY. Article X Environmental Inspector responsibilities included verifying all construction activities and environmental measures were performed in compliance with the certificate conditions, as well as all federal, state and local statutes, ordinances, rules and regulations. Responsibilities also included client coordination, oversight of hazardous and non-hazardous waste tracking and disposal, SWPPP inspection, and health and safety compliance.

Queens West Development Corporation – Queens, NY

Mr. Lindemuth served as the Site Construction Manager in connection with the remediation of a nine acre designated Brownfield (NYSDEC BCP Site Nos. C241095 and C241096) site in Long Island City, Queens, NY. Supervised a team of four environmental professionals during the excavation of approximately 100,000 tons of soil under negative pressure enclosures (tents), removal of Light Non Aqueous Phase Liquid (LNAPL) via high vacuum extraction and implementation of an in-situ chemical oxidation pilot test using direct injection methods and a five foot diameter soil mixing/injection tool, post-excavation (end point) soil sampling, post-remediation groundwater well construction and sampling and soil vapor sampling. Supervised supplemental remediation activities including excavation of approximately 10,000 cubic yards of “grossly contaminated” soil below a lower permeability “peat” layer and the water table. Responsibilities included staff supervision and management of daily reporting to NYSDEC Region 2, oversight of excavation, dewatering, management of separate phase product, off-site transportation and disposal of excavated material, post-excavation sampling, procurement of clean soil backfill, backfilling of excavations and implementation of the site SWPPP, community air monitoring program, and health and safety oversight. A certificate of completion was issued by NYSDEC in December 2010.

National Grid, Rockaway Park Former Manufactured Gas Plant (MGP) Site, – Queens, NY

Mr. Lindemuth periodically served as the Site Health and Safety Manager in connection with the remediation of the 9.8-acre National Grid Rockaway Park Former Manufactured Gas Plant (MGP) Site located in Queens, NY. The remedial activities performed included the excavation of over 150,000 tons of contaminated soil under negative pressure enclosures (tents) for off-site disposal. Responsible for providing daily health and safety briefings (tool box talks), performing real time air monitoring in the exclusion zone, implementing the necessary personal protective equipment (PPE) level, performing daily and weekly Health and Safety Inspections, and ensuring all site workers were in full compliance with the approved Site Specific HASP.

Stewart EFI – Yonkers, NY

Mr. Lindemuth served as a Senior Project Scientist and field team leader in connection with the Site Investigation, Remedial Investigation and Remedial Alternative Analysis of NYSDEC VCP Site No. V00691-3, and Voluntary Cleanup Agreement (VCA) Index No. W3-1005-04-06 located in Yonkers, New York. The Site consisted of over four acres developed with two parking lots, a residential structure, and a 200,000 square foot industrial building formerly utilized for metal parts manufacturing from 1942 until 2008, when manufacturing operations ceased. Field team leader responsibilities included staff supervision and management of mapping of on-site floor drains and piping, oversight of a geophysical survey, and implementation of a soil and groundwater investigation program. Responsible for report preparation including formulating conclusions and recommendations, subcontractor coordination, laboratory analytical results review and comparison to applicable regulatory criteria, and coordination with the client and NYSDEC. Company received a release and covenant not to sue letter from the NYSDEC in October 2011.

Con Edison Inc. – New York City, NY

Mr. Lindemuth served as a Senior Project Scientist for several subsurface investigations and hazardous materials building inspections at Consolidated Edison properties in New York. Served as a Project Scientist in connection with six hazardous material building inspections and two Phase II ESIs for Consolidated Edison properties. Responsibilities included implementation of Phase II ESI field programs and inspections of former substations to identify hazardous materials and characterize building materials prior to planned demolitions.

Atlantic Environmental Solutions, Inc., Hoboken, NJ

Mr. Lindemuth served as a Project Scientist responsible for supervising residential and light commercial projects involving: underground storage tank compliance (NJ); soil and groundwater remediation (NJ); Phase I ESAs, Phase II ESI; ISRA, BUST applicability (NJDEP), UST tightness testing (NY), Indoor Air Quality (NY and NJ); and managed asbestos surveys in several states. Project responsibilities included; project coordination and implementation, proposal writing, client and subcontractor coordination, NJDEP case manager coordination, report preparation, and budgeting.

Pennsylvania Department of Environmental Protection, Wilkes-Barre, Harrisburg, Williamsport, PA (Summers 2002–2004) – Engineering, Scientific & Technical Intern

SPECIALIZED TRAINING

- 4-Hour NYSDEC Erosion and Sediment Control Training, January 2014
- 8-Hour OSHA HAZWOPER Supervisor, August 2015
- 8-Hour OSHA HAZWOPER Refresher, February 2015
- 10-Hour OSHA Construction Safety Training, August 2015
- 30-Hour OSHA Construction Safety Training, September 2010
- 40-Hour OSHA HAZWOPER, August 2004
- Transportation Worker Identification Credential (TWIC)
- Secure Worker Access Credential (SWAC)

ELIZABETH A. DENLY

EDUCATION
B.A., Chemistry, University of New Hampshire, 1987

PROFESSIONAL REGISTRATIONS /CERTIFICATIONS
Licensed Site Professional Association, Massachusetts, Associate Member

AREAS OF EXPERTISE
Ms. Denly has over 25 years of experience in:

- Quality Assurance/Quality Control
- Data Validation
- Laboratory Audits
- Gas Chromatography: Field and Laboratory Analyses
- Gas Chromatography/Mass Spectrometry: Field and Laboratory Analyses

Quality Assurance/Quality Control
As a QA chemist at TRC, Ms. Denly is responsible for providing QA/QC oversight in support of a variety of environmental investigations including contaminant ambient air monitoring, human health and ecological risk assessments, risk-based soil cleanups, remediation programs, and delineation. Ms. Denly has provided this oversight under different regulatory programs, including NYSDEC, NJDEP, MassDEP and USEPA Region I, Region II, Region III, and Region V. In this role, she has been responsible for the preparation of the project-specific QAPP, coordination with the laboratory, selection of the appropriate analytical methodologies to achieve the desired state or regulatory standards, oversight and performance of the data validation process, and determination of the usability of the data in comparison to the overall project objectives.

In addition, Ms. Denly serves as the TRC Environmental Sector and Remediation Practice Quality Coordinator, responsible for the creation and implementation of the TRC Environmental Sector Quality Management Plan.

Data Validation
Ms. Denly provides oversight and senior review on data validation performed for a variety of analytical parameters. She performs data validation for organic parameters including VOCs, SVOCs, Pesticides, PCB Aroclors, PCB homologues/congeners, dioxins, specialty analyses including GC/MS/SIM and various air analyses. Validation and reporting guidelines utilized include EPA National Functional Guidelines, USEPA Regions I through V, NYSDEC, and NJDEP. Ms. Denly developed internal protocols for the validation of the MassDEP EPH/VPH methodologies.

REPRESENTATIVE EXPERIENCE

New York City School Construction Authority
Ms. Denly assisted in the preparation of QA protocols for a pilot study to evaluate the possible presence of PCB in building materials and preferred remedial remedies in select schools constructed between 1950 and 1978. QA protocols included sampling and analysis procedures for PCBs in several matrices (caulk, wipes, soil, air and bulk). Ms. Denly was responsible for reviewing field team documentation, providing oversight of the analytical laboratory, and coordinating data validation. She was responsible for frequent communication with the laboratories to ensure proper receipt of samples, proper utilization of project-specific analytical protocols in order to achieve necessary project action levels, and to monitor the overall performance of the laboratories. Ms. Denly coordinated with the laboratories to ensure proper cleanup procedures were performed on difficult bulk matrices from the school buildings to confirm the highest level of data defensibility.

130 Liberty Street – New York, NY
Ms. Denly developed the QAPP for the extensive ambient air monitoring program and waste management program under USEPA Region II oversight. Ms. Denly provided oversight of six analytical laboratories and was responsible for coordination and performance of data validation for asbestos, metals, dioxins/furans, PAHs, PCBs, and silica ambient air data as well as TCLP and metals waste characterization data. Ms. Denly communicated frequently with the laboratories to ensure proper receipt of samples, proper utilization of project-specific analytical protocols and to monitor the overall performance of the laboratories. Responsible for the oversight and performance of field and laboratory audits. Reviewed all data prior to web-site posting and submission to USEPA.

Mattiace Petrochemical – Glen Cove, NY
Ms. Denly prepared the QAPP for the Long Term Remedial Action under TRC's Exit Strategy® program using USEPA Region II guidance. She provided QA oversight to the field team. Ms. Denly also performed data validation of data generated for demonstration of achievement of cleanup objectives. Ms. Denly was responsible for performing assessment of data to determine overall usability.

Queens West Development – Stage 2 Site – Long Island City, NY
Ms. Denly prepared the QAPP for the NYSDEC Voluntary Cleanup Program under TRC's Exit Strategy® program. She provided QA oversight to the field team. Ms. Denly performed data validation for the program. She was responsible for performing assessment of data to determine overall usability. Ms. Denly provided daily support to the project team on chemistry, laboratory, and

QA issues. She was responsible for ensuring project objectives were achieved by the laboratory and for oversight of laboratory QA issues.

Consolidated Edison First Avenue Properties – New York, NY
Ms. Denly prepared a QAPP for Supplemental Soil Investigation and Voluntary Cleanup of four sites under TRC's Exit Strategy® program. She provided QA oversight to field team. Ms. Denly performed data validation of select data points used for decision-making and was responsible for performing assessment of data to determine overall usability for various Remedial Work Plans.

New Bedford High School – New Bedford, MA
Ms. Denly serves as Project QA Manager and PCB chemistry expert for the investigation and remediation of multiple PCB containing building materials. Responsibilities include reviewing all field notes, performing data validation, preparing of data usability assessments and overseeing the analytical laboratories.

Woodbrook Road Superfund Site – South Plainfield, NJ
Ms. Denly developed the QAPP for a complex remedial investigation under USEPA Region II oversight. The program involved use of the TRIAD approach for real-time PCB results for sampling and analysis of soil, sediment, groundwater, and surface water for all TCL/TAL parameters, dioxins/furans, PCB congeners, and a variety of wet chemistry parameters, most of which will be used in a human health/ecological risk assessment. Ms. Denly was responsible for providing oversight of three analytical laboratories and for coordination of data validation for all parameters. She communicated frequently with the laboratories to ensure proper receipt of samples, proper utilization of project-specific analytical protocols in order to achieve necessary project action levels, and to monitor the overall performance of the laboratories. Ms. Denly is responsible for the oversight and performance of field and laboratory audits.

FAA, Region II – Atlantic City, NJ
Ms. Denly assisted in the preparation of QA protocols for the Supplemental RI and Ecological Risk Assessment Work Plan. She was also responsible for providing QA support to the field team. Ms. Denly interfaced with laboratories to ensure achievement of risk-based standards and performed data validation and/or oversight for all data generated. Ms. Denly provided oversight for all validation performed on the Remedial Investigation data.

USEPA Region I Superfund RAC – MA
Ms. Denly served as lead chemist for a variety of Superfund programs under the USEPA Region I Remedial Action Contract (RAC). Her responsibilities have included ongoing development of analytical specifications for laboratories to achieve specific project objectives and development of QAPPs following the requirements of USEPA Region I QAPP guidelines. She performs data validation

and/or senior review of data validation for a variety of analytical methodologies utilizing USEPA Region I validation guidelines. Ms. Denly generates data usability assessments and/or split sample comparison reports in accordance with USEPA Region I guidance, when required. She interacts with USEPA Region I chemists in the selection of analytical methodologies and project objectives. Ms. Denly provides QA oversight of PRPs' validation reports, sampling and analysis plans, and QAPPs. She is also responsible for providing QA oversight to field teams, performing daily reviews of COCs and traffic reports, and acting as the main liaison between the field team and USEPA.

Massachusetts Department of Environmental Protection – MA
Ms. Denly is currently providing assistance to MassDEP to determine whether the regulated community is correctly implementing analytical methodologies at MassDEP sites; this includes providing training for all MassDEP auditors. Ms. Denly is also assisting MassDEP in the development of a protocol for the analysis of volatile petroleum hydrocarbons (VPH) by GC/MS. Previously, Ms. Denly has assisted MassDEP in the review/evaluation of data packages for EPH/VPH analyses from laboratories selected by MassDEP as part of a Data Audit project to ensure compliance with the methods and CAM. She provided consultation to MassDEP for revisions to the MassDEP's innovative EPH/VPH analytical methods used to measure petroleum hydrocarbon concentrations in soil and groundwater. Ms. Denly served as a member of the Data Quality Enhancement Work Group lead by MassDEP and assisted in the development of a policy for achieving consistency of data reported under the MCP. Ms. Denly was designated as the Organic Subcommittee Chairperson responsible for generating the framework for QC parameters on organic analyses typically utilized under the MCP, method-specific performance standards for these QC parameters, minimum reporting requirements for the laboratories for each method, and a list of what laboratories need to keep on file for potential audits by the MassDEP. She was responsible for generating the final deliverable on all organic method requirements developed under this Work Group, providing significant input into the development of requirements for inorganic methods as well as field sampling QC requirements, and LSP data usability assessment requirements.

Consolidated Edison Company, Electrical Power Generator – NY
Ms. Denly performed a method validation study to establish the applicability of an ASTM UV method for the measurement of dielectric fluids in soils. Detection limits, precision, accuracy, and comparability to laboratory analyses were investigated for each oil.

Consolidated Edison Company, Electrical Power Generator – NY
Ms. Denly prepared and analyzed soil samples for an RFI of the facility in Astoria, New York. She quantitatively identified samples for TPH by GC/FID. Ms. Denly performed qualitative identification of the soils based on analysis of

several of categories of oils used at the facility, including fuel oil #2, fuel oil #6, transformer oil, gas condensate, and dielectric fluids.

PUBLICATIONS AND PRESENTATIONS

Denly, E. Chapnick, S., "*Is Presumptive Certainty Generating Usable Data for Massachusetts Contingency Plan (MCP) Decisions?*" Paper presented at Twentieth Annual Conference on Contaminated Soils, Sediments and Waters, Amherst, MA. 2004.

Denly, E., Hoyt, M., Anastas, N., Fitzgerald, J., Hutcheson, M., McGrath, T., "*Massachusetts VPH Method Validation for Indoor Air Samples"*. Poster presented at Thirteenth Annual Conference on Contaminated Soils, Amherst, MA. 1998.

Denly, E. Hopper, D., *"Field Chemistry for PAHs and VOCs Applied to a Risk-Based Soil Cleanup at a Landfill"*, Paper presented at Fifth International Symposium on Field Analytical Methods for Hazardous Wastes and Toxic Chemicals, Las Vegas, NV. 1997.

Denly, E., Hoyt, M., Camp, W.H., Naughton, G., *"Method Validation Study for Field Screening of Dielectric Fluids in Soils"*, Paper presented at Twelfth Annual Conference on Contaminated Soils, Amherst, MA. 1997.

Denly, E., Wang, H., *"Preparation of Tedlar Bag Whole Air Standards with a SUMMA Canister for Field VOC Analysis"*, Poster presented at Fourth International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals, February 22-24, 1995, Las Vegas, NV.

SPECIALIZED TRAINING

- Data Evaluation for Vapor Intrusion Studies, 9/07
- Sediment Toxicity Testing: Methods to Achieve Strong Data Sets and Interpret Results, 6/07
- Assessing the Vapor Intrusion Pathway at Contaminated Sites, NHDES Waste Management Division, 4/05
- Perchlorate Webinar, US EPA, 2/05
- Improved Project Communication: Within and Outside of the Project Team, ASCE Continuing Education Program, 12/15/04
- Communicating with Tact and Skill for Managers and Supervisors, Rockhurst University Continuing Education Center, 2004
- Training Session for USACE-NAE/USEPA Region I Regional Implementation Manual, 10/7/04
- Training for Non-Trainers, US EPA, 9/04
- Overview of Statistical Data Quality Assessment, US EPA, 9/04
- Assessing Quality Systems, US EPA, 9/04

- Understanding and Evaluating Data Quality Assessments, US EPA, 9/28/04
- PowerPoint 2000 – Level 1, New Horizons Computer Learning Centers, 12/03
- EPA Forms II Lite Training Course, 9/23/03
- MA DEP: “Beyond TPH: Understanding and Using the New EPH/VPH Approach”
- Arthur D. Little: "Advanced Chemical Fingerprinting of Petroleum Contaminated Soils and Water"
- ACS Short Course: "How to Develop and Troubleshoot Capillary GC Methods"
- ORA/RSA Workshop: Optical Remote Sensing
- Finnigan MAT: "Basic Mass Spectral Interpretation"
- Finnigan MAT: "Advanced Environmental MS Interpretation"

PATRICK NAREA, CPG

EDUCATION
B.A., Geology, State University of New York at Buffalo, 1998

PROFESSIONAL REGISTRATIONS/CERTIFICATIONS
Certified Professional Geologist (CPG) – American Institute of Professional Geologists

AREAS OF EXPERTISE
Mr. Narea has 14 years of experience and has assumed progressively increasing responsibilities in environmental consulting. His experience includes environmental investigation, environmental remediation, and construction inspection and management. Mr. Narea's has provided environmental consulting services, serving the role of hydrogeologist and geologist, to the MTA Long Island Rail Road, New York City School Construction Authority, Queens West Development Corporation, New York City Department of Environmental Protection, New York City Economic Development Corporation, National Grid and Consolidated Edison of New York. He currently serves in the capacity of Project Manager in TRC's Remediation Practice and is based in the midtown Manhattan office.

Mr. Narea has experience in the following general areas:

- Project Management
- Environmental Site Assessment/Investigation
- Environmental Remediation
- Construction Inspection and Construction Management
- Underground Storage Tank Testing, Removal, and Closure
- Vapor Intrusion Investigation and Ambient Air Monitoring

REPRESENTATIVE EXPERIENCE

The Port Authority of NY & NJ - Goethals Bridge Replacement Project - Staten Island, NY
TRC was assigned the task of implementing Phase II Environmental Site Investigations on properties on the New York side in connection with the Goethals Bridge Replacement Project, and Mr. Narea served as the project geologist and assistant project manager for the site investigation activities. Mr. Narea implemented the work plan for each property under challenging conditions and an aggressive schedule, which required specialized boring techniques within coastal areas, coordination with tidal changes, utilization of portable GPS equipment in the field, and employment of a tablet computer for use of EarthSoft® EQuIS Data Gathering Engine (EDGE) software for recording field data. Mr. Narea prepared the four Phase II Environmental Site Investigation Reports, and was also responsible for maintaining, compiling and presenting photographic documentation to the New York City Department of Parks & Recreation to demonstrate no adverse impacts to the properties as a result of the investigation activities.

MTA Long Island Rail Road (LIRR) - West Side Storage Yard – New York, NY
Mr. Narea served as the project hydrogeologist and assistant project manager for the environmental investigation of an open spill case which was assigned to the LIRR West Side Storage Yard (NYSDEC Spill No. 0407411) in Manhattan. He supervised the field activities, performed in accordance with a NYSDEC-approved work plan, which included installation and sampling of groundwater monitoring wells, characterization of the local groundwater flow regime, a tidal influence study, and the delineation of petroleum contaminated soil and groundwater. The field activities were performed on an active rail yard with limited site access, adjacent to the Hudson River, and at NYSDEC's request included collecting groundwater samples from each monitoring well at multiple depth intervals using low-flow sampling techniques. Mr. Narea prepared the RI Report which included high and low tide groundwater surface elevation contour maps and recommendations for future site management activities.

New York City School Construction Authority
Under TRC's on-call hazardous materials services contract with the New York City School Construction Authority, Mr. Narea served as the project hydrogeologist and project manager for preparation and implementation of the remedial investigation work plan and preparation of the RI report for a petroleum contaminated site (NYSDEC Spill No. 0508302) located on Jerome Avenue in the Bronx. The site, known as the New Settlement Community Center, has been re-developed into a New York City public school and community center. Mr. Narea supervised the waste characterization sampling for disposal, and delineation of petroleum contaminated soil and a floating gasoline plume. He supervised field activities, which included investigation of shallow bedrock for petroleum-related impacts, including collection of rock cores and construction of a bedrock well. Mr. Narea prepared the RI Report, including bedrock and groundwater surface elevation contour maps. The RI report, which included detailed recommendations for remediation, was accepted by NYSDEC Region 2.

New York City Economic Development Corporation
Mr. Narea has been responsible for the investigation and report preparation in connection with several Phase II Environmental Site Investigations for the New York City Economic Development Corporation. The scopes of the investigations included assessment of soil, groundwater, soil vapor and sub-slab vapor. Mr. Narea also served as the environmental construction manager during the remediation and construction of a minor league ballpark on a former railroad site. Mr. Narea oversaw the implementation of the remedial action work plan, community air monitoring program, storm water pollution prevention plan, and health and safety.

Columbia University – On-Call Environmental Consulting Services Contract - New York, NY
Mr. Narea serves as Project Manager for TRC's on-call environmental services contract with Columbia University and has lead efforts in connection with petroleum spill case closures (NYSDEC Spill Case Nos. 11-14060 and 12-06786). His

responsibilities have included site investigation, oversight of tank closures and removals, and closure report preparation.

Consolidated Edison Company - Hudson Avenue Generating Station - Brooklyn, New York

Mr. Narea served as the project hydrogeologist and project manager for the environmental investigation of a part of the Consolidated Edison (Con Edison) Hudson Avenue Generation Station property, located in Brooklyn, New York, in support of a project known as the “Hudson Avenue Replacement Project” (HARP). Con Edison was proposing to construct a new generating plant on the project site to replace the existing steam plant. The planned project area encompasses areas of known spills of petroleum products. The field activities, supervised by Mr. Narea, included the investigation of deep bedrock for manufactured gas plant (MGP) impacts, which included the collection of 30 rock cores. Rock cores were visually inspected and screened with a PID by Mr. Narea for MGP impacts, and the RQD for each rock core was recorded. Mr. Narea also supervised the delineation of petroleum contaminated soil and light non-aqueous phase liquid (LNAPL) within the planned project site via installation of soil borings and groundwater monitoring wells, and performed sub-slab soil vapor sampling in the basement of the maintenance building on the project site. Mr. Narea prepared the Site Investigation Report which included groundwater surface elevation contour maps and recommendations for remediation.

ATTACHMENT 3

SAMPLING SOPs

ATTACHMENT 4

SAMPLE CHAIN-OF-CUSTODY

CHAIN OF CUSTODY

PAGE ___ OF ___

ACCUTEST LABORATORIES
2235 Route 130, Dayton, NJ 08810
TEL. 732-329-0200 FAX: 732-329-3499/3480
www.accutest.com

FED-EX Tracking #	Bottle Order Control #
Accutest Quote #	Accutest Job #

Client / Reporting Information

Company Name: TRC Engineers, Inc.

Street Address: 1430 Broadway, 10th Fl

City: New York State: New York Zip: 10018

Project Contact: Wes Lindemuth E-mail: WLindemuth@trcsolutions.com

Phone #: 212-221-7822 Fax #: 212-221-7840

Sampler(s) Name(s) Phone #

Project Information

Project Name: Red Hook Ballfields 5-8

Street: Bay/Hicks Street

City: Brooklyn State: NY

Project #: 246184

Client Purchase Order #

Project Manager: Wes Lindemuth

Billing Information (if different from Report to)

Company Name

Street Address

City State Zip

Attention:

Requested Analysis (see TEST CODE sheet)

Accutest Sample #	Field ID / Point of Collection	MEOH/DI Vial #	Collection Date	Collection Time	Sampled by	Matrix	# of bottles	Number of preserved Bottles: HCl	NaOH	HNO3	H2SO4	NONE	DI Water	MEOH	ENCORE	AB8270SCO (Part 375 SVOCs)	MTAL + SN (TAL Metals + Tin)	CN (Cyanide)	CR3 (Tri Chrom)	XCRA (Hex Chrom)	H8151245TP (Part 375 Herb)	P8081SCO (Part 375 Pest)	P8082PCB (TCL PCBs)	V8260SCO (Part 375 VOCs)	Particle Size (ASTM D 422)		LAB USE ONLY

Matrix Codes

DW - Drinking Water
GW - Ground Water
WW - Water
SW - Surface Water
SO - Soil
SL- Sludge
SED-Sediment
OI - Oil
LIQ - Other Liquid
AIR - Air
SOL - Other Solid
WP - Wipe
FB-Field Blank
EB-Equipment Blank
RB- Rinse Blank
TB-Trip Blank

Turnaround Time (Business days)

Approved By (Accutest PM): / Date:

- [X] Std. 10 Business Days
- [ ] 5 Day RUSH
- [ ] 3 Day RUSH
- [ ] 2 Day RUSH
- [ ] 1 Day RUSH
- [ ] other _____

Emergency & Rush T/A data available VIA Lablink

Data Deliverable Information

- [ ] Commercial "A" (Level 1)
- [ ] Commercial "B" (Level 2)
- [ ] FULLT1 (Level 3+4)
- [ ] NJ Reduced
- [ ] Commercial "C"
- [ ] *NJ Data of Known Quality Protocol Reporting*
- [ ] NYASP Category A
- [X] NYASP Category B
- [ ] State Forms
- [ ] EDD Format _____
- [ ] Other _____

Commercial "A" = Results Only, Commercial "B" = Results + QC Summary

NJ Reduced = Results + QC Summary + Partial Raw data

Comments / Special Instructions

Sample inventory is verified upon receipt in the Laboratory

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
1		1	2		2
Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
3		3	4		4
Relinquished by:	Date Time:	Received By:	Custody Seal #	Preserved where applicable	On Ice / Cooler Temp.
5		5	☐ Intact ☐ Not intact	☐	☐

Accutest Laboratories Chain of Custody Instructions

Client/ Reporting Information

Enter the company name, address, phone number, and person designated to receive the analytical report. Sampler's full name(s) and phone number needs to be entered in case the laboratory discovers a sampling anomaly and needs to make a call. The name(s) will correspond with sampler's initials listed in the collection section under sampled by.

Project Information and Billing Information

Fill in all of the requested information that is available. This information is critical to matching up specific project and billing information in our LIMS to the job listed on the chain. The state of origin must be filled in to ensure that our reporting format meets the requirements of that specific state and to ensure that we have certifications for that state.

Field ID/ Point of Collection and Collection information

CLEARLY, write in the sample ID, dates, times and samplers initials. All information must be legible. Use one line per sample point unless the sample was taken at multiple times for different tests. In such a case use a separate line for the bottles taken at different times. Enter the date, and time of each sample. Please note AM and PM or use Military time. Check this information and the Field IDs against the information recorded on the bottles. Make sure all information matches exactly.

Matrix, # of Bottles, Number of preserved bottles

Standard abbreviations for matrix codes are listed on the right side of the chain. DW- Drinking Water, GW-Ground Water, WW- Water or Wastewater, SW- Surface Water, SO- Soil, SL- Sludge, SED-Sediment, OI- Oil, LIQ- Other Liquid, SOL- Other Solid, WP- Wipe, AIR- Air. FB- Field Blank, RB- Rinse Blank, EB- Equipment Blank, TB- Trip Blank. Enter the matrix code in the matrix column. Enter the total number of bottles for the sample in the designated column and list the number of bottles of each preservative type in the designated column. One field under preservation has been left blank and can be filled in if an unlisted preservative was used.

Requested analysis

The last page of the chain of custody form contains a list of the most common tests performed. If the analysis you require is listed here, please use the Accutest **TEST CODE** and write it in the columns labeled under "Requested Analysis". If the analysis you require cannot be found on the list, please state the analysis as clearly as possible in the columns by providing the analytical method and reporting list where applicable. Put an X in the box correlating with each test needed for the samples listed on the chain. If an analysis is on HOLD do not put an X in the column for that test, use an H and Footnote in the comments section H= HOLD. It is your responsibility to contact the lab to activate any contingent samples placed on HOLD pending review of the data for the first tier analysis. Samples placed on HOLD will only be held for 30 days after report completion. If the most current New Jersey Groundwater criteria must be met, Please indicate this on the chain. (MUST MEET CURRENT NJ GW CRITERIA)

Accutest Quote Number and Bottle Order Control Number

If the quote number is known, please write the quote number in this field. The bottle order control number is listed on the bottle order form, which was delivered with the coolers. Please write in the number from this form in this field

Accutest Sample #, Accutest Job Number, and LAB USE ONLY Fields

Do Not write in these fields

Turnaround Time (business days)

Put an X in the box next to the desired turnaround time. Turnaround time is calculated using business days, M-F. For multiple turnaround times, clearly designate the turnaround for specific samples and tests. Use the comment section or list a special turnaround time next to the test in the requested analysis section if necessary. If the turnaround time is not listed, the samples will be run at standard turnaround time.

Data Deliverable Information

Put an X next to the hardcopy report package type that is required. COMMA (Results only), COMMB (Results and QC summaries), NJREDT2 (Results, QC Summaries, and partial raw data). FULLT1 (Results, QC Summaries, and all raw data), NYASPA (Results only), NYASPB (Results, QC Summaries, and all raw data), CLP (Results, QC Summaries, and raw data according to CLP statement of work). Deliverables must be selected for all jobs. Failure to designate deliverable type could result in incorrect log in, analysis, and reporting of the final data package.

Sample Custody Transfer

All sample transfers must be signed and dated by the person relinquishing the samples and the person receiving the samples. Missing signatures and custody information could invalidate all work done on the job. Fill in the custody seal number in the section designated at the bottom of the chain.

Comments

If there are any special instructions, write them in this field. If the metals samples are to be lab filtered, document this in the comment section. Metals samples submitted for lab filtration must be unpreserved.

General

If there is more than a one page chain of custody, write in the upper left-hand corner, 1of 2, 2 of 2 etc. for the pages submitted. This is to indicate to Accutest that the samples are all to be put on one job upon assignment of our job and sample numbers.

The chain of custody is a legal document, use only black or blue ink and do not use whiteout or correction tape. To correct an error, either rewrite the document; or draw a single line through the incorrect information, and write in the corrected information. Date and initial all strikeouts.

If any problems or questions arise in the field, please call the laboratory at (732) 329-0200 and ask for your project manager

COMMON LABORATORY TEST CODES

Accutest Test Code	Parameter Description
VOLATILES	
Add "+" to 624,8260 or 524	For Library search (TIC's) +10 or +15
V624PPL or V8260PPL	PPL Volatiles (EPA 624 or SW846 8260)
V624TCL or V8260TCL	TCL Volatiles (EPA 624 or SW846 8260)
V524STD or V524DWFULL+ (NJ)	Volatile organics (EPA 524.2)
V602BTX or V8021BTX	BTEX (EPA 602 or SW846 8021)
V602BTXM or V8021BTXM	BTEX + MTBE (EPA 602 or SW846 8021)
V624BTXM or V8260BTXM	BTEX + MTBE (EPA 624 or SW846 8260)
V624BTXMT or V8260BTXMT	BTEX + MTBE + TBA (EPA 624 or SW846 8260)
V624BTXMN or V8260BTXMN	BTEX + MTBE + Naphthalene (EPA 624 or SW846 8260)
V624OXY5 or V8260OXY5	Oxygenetes (MTBE, TBA, DIPE, IPE, TAME) (EPA 624 or SW846 8260)
V624BTXOXY5 or V8260BTXOXY5	BTEX + Oxygenates (EPA 624 or SW846 8260)
V8015GRO	TPH (GRO) (SW846 8015)
V8260PAUG	PA Unleaded Gas (SW846 8260)
V8260PALG	PA Leaded Gas (SW846 8260)
V8260PADF	PA Diesel Fuel (SW846 8260)
V8260PALO	PA Lubricating Oils (SW846 8260)
V8260PAUMO	PA Used Motor Oil (SW846 8260)
V8260STAR	NY Stars List (SW846 8260)
V8011EDB	Ethylene Dibromide (1,2 Dibromoethane) (SW846 8011)
V8260STD	Full List Volatiles
V8015CO2	Carbon Dioxide by GC
V8015DGMEE	Methane , Ethane, Ethene
V8260ETHL, or D8015ETHL	Ethanol (SW846 8260 or 8015)

For additional compounds such as MTBE, TBA, NAP, TMB Oxygenates etc., please write the abbreviation on the chain.

GC or GC/MS SEMI-VOLATILES	
Add "+" to 625 or 8270	For Library search (TIC's)
AB625PPL or AB8270PPL	PPL (Base Neutral and Acid Extractables) (EPA 625 or SW846 8270)
B625PPL or B8270PPL	PPL(Base Neutral Extractables) (EPA 625 or SW846 8270)
A625PPL or A8270PPL	PPL (Acid Extractables) (EPA 625 or SW846 8270)
AB625TCL or AB8270TCL	TCL (Base Neutral and Acid Extractables) (EPA 625 or SW846 8270)
B625TCL or B8270TCL	TCL (Base Neutral Extractables) (EPA 625 or SW846 8270)
A625TCL or A8270TCL	TCL (Acid Extractables) (EPA 625 or SW846 8270)
B625PAH or B8270PAH	Polynuclear Aromatics (EPA 625 or SW846 8270)
V504EDB or V8011EDB	1,2-Dibromoethane (EDB) (EPA 504.1 or SW846 8011)
XP608PPPPL	PPL Pesticides/PCBs (EPA 608)
XP608PPTCL	TCL Pesticides/PCBs (EPA 608)
XPPPPL	PPL Pesticides/PCBs (SW846 8081 or 8082)
XPPTCL	TCL Pesticides/PCBs (SW846 8081 or 8082)
P608PESTTCL or P8081PESTTCL	TCL Pesticides (EPA 608 or SW846 8081)
P608PESTPPL or P8081PESTPPL	PPL Pesticides (EPA 608 or SW846 8081)
P608PCB or P8082PCB	PCBs (EPA 608 or SW846 8082)
H8151STD	Chlorinated Herbicides Short List (SW846 8151)
H8151FL	Chlorinated Herbicides Full List (SW846 8151)
B8015DRO	TPH (DRO) (SW846 8015)
BNJ025TPHC	TPH New Jersey OQA-QAM-025
B8015FING	GC Fingerprint (SW846 8015)
LC8315FORM	Formaldehyde (SW846 8315)
B8270PADF	PA Diesel Fuel (SW846 8270)
LC8310PALO or B8270PALO	PA Lubricating Oils (SW846 8310 or 8270)
LC8310PAUMO or B8270PAUMO	PA Used Motor Oil (SW846 8310 or 8270)
B8270STAR	NY Stars List (SW846 8270)
Air	
VTO15STD	Volatile Organics (TO15) Full list (VTO15STD+ if TICs are needed)
VTO15BTX…M… T	Volatile Organics (TO15) BTX…. MTBE ,TBA
VTO3BTX	BTEX (TO3)
VTO3BTXCH4	BTEX, Methane (TO3)
VTO3BTXM	BTEX, MTBE (TO3)
VTO3BTXMTPH	BTEX, MTBE, TPH (TO3)
VTO3BTXMTPHF	BTEX, MTBE, TPH Fractionated (TO3)
VTO3TPHF	TPH Fractionated (TO3)
VTO3TPH	TPH (TO3)
METALS	
HG	Mercury (EPA 245, SW846 7470 or 7471)
HM8	8 RCRA Metals (SW846)
PM13	PPL Metals Package (EPA 200 or SW846)
MTAL	TAL Metals Package (EPA 200. or SW846)

Test Code	Parameter Description
WET CHEMISTRY/INORGANICS	
ACD	Acidity (SM20 2310B)
ALK	Alkalinity (SM 2320B)
ASH	Percent Ash (ASTM D482-91)
BIC	Bicarbonate (SM18 4500 CO2 D)
BOD	BOD (SM 5210B)
BRO	Bromide (EPA 300/SW846 9056)
BTU	BTU (ASTM D240-92)
CAR	Carbonate (SM18 4500 CO2 D)
XCO2	Carbon Dioxide (SM18 4500 CO2 C) **or see Volatiles**
CHL	Chloride (EPA 300/SW846 9056)
TRC	Chlorine, Residual (SM 19 4500-CIF)
COD	COD (HACH 8000/SM20 5220C)
COL	Color, Apparent (SM19 2120B)
CN	Cyanide, Total (EPA 335.4/SW846 9012/Lachat)
PCNA	Cyanide, Amenable (SM 20 4500CNG/ SW846 9012M)
BDENS	Bulk Density (ASTM D2937-94M)
F	Fluoride (EPA 300/SW846 9056)
FE2	Ferrous Iron (SM 20 3500 FE-D)
FE3	Ferric Iron (SW846 200.7/SM20 3500FED)
GRAINS	Grain Size W/ Hydrometer (ASTM D422)
SIEVE	Grain Size W/O Hydrometer (ASTM D422)
HRD	Hardness (SM19 2340C)
XXCRA	Hexavalent Cr (SO- SW846 3060A, 7196A, or 7199)
XCR	Hexavalent Cr (AQ - SW846 7196A, 7199 or SM19 3500 CR D)
AMN	Nitrogen, Ammonia (SM20 4500NH3G/Lachat)
XNO3O	Nitrogen, Nitrate (EPA 353.2/SM 4500NO2B)
NO32	Nitrogen, Nitrate+Nitrite (EPA 353.2/Lachat
NO2	Nitrogen, Nitrite (SM19 4500NO2B)
TKN	Nitrogen, Total Kjeldahl (EPA 351.2/Lachat
OG1664	Oil and Grease -Total (EPA 1664A (HEM)), SW846 9071B)
DO	Oxygen, Dissolved (SM20 4500 OG)
XPERCHLT	Perchlorate (EPA 314/314 M)
PH	pH (SM20 4500 H B/SW846 9040B/(9045C
OPO4	Phosphorus, Ortho (SM20 4500 PE)
TPO4	Phosphorus, Total (EPA 365.3)
TDS	Residue - Filterable (TDS) (SM20 2540 C)
TSS	Residue - Nonfilterable (TSS) (SM20 2540 D)
SS	Residue - Settleable (SS) (SM20 2540 F)
TS	Residue - Total Solids (TS) (SM20 2540 B)
TVS	Residue - Volatile (TVS) (EPA 160.4)
SIL	Silica, Dissolved (SM19 4500SIO2D)
SCON	Specific Conductance (SM19 2510B/SW846 9050A)
%SOL	% Solids (EPA 160.3M/ASTM 4643)
SULFUR	% Sulfur (ASTM D129)
SO4	Sulfate (EPA 300/SW846 9056)
S	Sulfide (SM20 4500 S2 F)
S03	Sulfite (SM20 4500 SO3B)
MBAS	Surfactants (MBAS) (SM20 5540C)
TOC	Total Organic Carbon (TOC) Aqueous (SM20 5310B,9060M)
TOC	Total Organic Carbon (TOC) Soil (Corp Eng 81M/SW846 9060M)
TOCLK	Total Organic Carbon (TOC) Soil (Lloyd Kahn Method 1998)
TOX	Total Organic Halides (TOX) (SW846 9020B/9023M)
PN	Total Phenolics (420.4/SW846 9066/Lachat)
PHC	Total Petroleum Hydrocarbons (EPA 418.1/418.1M)
PHC1664	Petroleum Hydrocarbon- (EPA 1664A SGT-HEM) , Non Polar
TURB	Turbidity (EPA 180.1)
TCF	Coliform, Total (SM19 9222B) Groundwater/Wastewater
TCFC	Colilert (SM 9223B) Drinking Water Only
FCF	Coliform, Fecal (SM18 9222D)
TPC	Standard Plate Count (SM19 9215B)
GPD	General Petroleum Degraders (Accutest In-House Method)

Test Code	Parameter Description
RCRA / Waste Characterization/ TCLP	
IGN	Ignitability (SW846 Chapter 7)
CORR	Corrosivity (SW846 Chapter 7)
CREAC, SCREAC	Reactive CN, S (SW846 Chapter 7)
RCRACLAS	(All the above) IGN,CORR,CREAC,SREAC
PNTFIL	Paint Filter Test
TCLPFULL	Full TCLP (includes all groups below)
TCLPM	TCLP Metals (SW846)
V8260TCLP	TCLP Volatiles (SW846 8260)
AB8270TCLP	TCLP Semivolatiles (SW846 8270)
P8081TCLP	TCLP Pesticides (SW846 8081)
H8151TCLP	TCLP Herbicides (SW846 8151)
Packages	
PP+40	Priority Pollutants - Full, (VOA, BNA, Pest/PCB, Metals, PN & CN)
TCL+	TCL & TAL - Full, (VOA, BNA, Pest/PCB, Metals & CN) TICS
Petroleum Hydrocarbon Tests	
B8015DRO	TPH (DRO) (SW846 8015)
BNJ025TPHC	TPH New Jersey OQA-QAM-025
V8015GRO	TPH (GRO) (SW846 8015)
PHC	Total Petroleum Hydrocarbons (EPA 418.1/418.1M)
PHC1664	Petroleum Hydrocarbon- (EPA 1664A SGT-HEM) , Non Polar
BNJEPH	New Jersey EPH with Full Fractionation
BNJEPHCAT1	New Jersey Category 1 EPH without Fractionation
BNJEPHCAT2NF	New Jersey Category 2 EPH with contingent Fractionation

New Jersey Technical Rule Test Codes (Groundwater samples)

Please go to - http://www.state.nj.us/dep/srp/regs/techrule/

TCL Volatiles- To meet all NJ GW criteria	
V8260NJPTCL11+10	(SW846 8260) TCL Volatiles Minus EDB,DBCP, 1,4 Dioxane
V8011NJ	(SW846 method 8011) EDB ,DBCP
V8260SIMDIOX	(SW846 8260 SIM) 1,4 Dioxane
TCL Volatiles- To meet NJ GW criteria for all but 1,4 Dioxane	
V8260NJTCL11+10	(SW846 8260) TCL Volatiles Minus EDB,DBCP
V8011NJ	(SW846 method 8011) EDB ,DBCP
TCL Volatiles for Most Petroleum impacted sites	
V8260NJPTCL11+10	(SW846 8260) TCL Volatiles minus EDB,DBCP and 1,4 Dioxane
ABN Semivolatiles - To meet all NJ GW Criteria	
AB8270NJTCL11+	(SW846 8270) SCAN Component TCL Acid /Base Neutrals
AB8270SIMNJ	(SW846 8270 SIM) SIM component ABN Semivolatiles
BN Semivolatiles - To meet all NJ GW Criteria	
B8270NJTCL11+	(SW846 8270) SCAN Component TCL Base Neutrals
B8270SIMNJ	(SW846 8270 SIM) SIM component BN Semivolatiles
Metals- To meet NJ GW Criteria	
MTALNJ	TAL metals
ASNJ, TLNJ	Arsenic and Thallium
See metals symbols below	All other metals
FULL TCL Volatiles List including all compounds (AQ or SO)	
V8260TCL11+	(SW846 8260) TCL Volatiles
NJ Soils	
TCL Volatiles for Petroleum Impacted sites	
V8260NJPTCL11+10	(SW846 8260) TCL Volatiles Minus EDB,DBCP, 1,4 Dioxane

If the analysis you require cannot be found on this list, please describe the analysis as clearly as possible on the Chain of Custody. For Metals and Organic analysis not listed on this table, please provide the analytical method and reporting list. If the most current New Jersey GW or Soil criteria must be met, Please indicate this on the chain.

Individual Metal Codes Al (Aluminum), Ag (Silver), As (Arsenic), B (Boron), Ba (Barium), Be (Beryllium), Ca (Calcium), Cd (Cadmium), Co (Cobalt), Cr (Chromium), Cu (Copper), Fe (Iron), Hg (Mercury), K (Potassium), Mg (Magnesium), Mn (Manganese), Mo (Molybdenum), Na (Sodium), Ni (Nickel), Pb (Lead), Pd (Palladium), Sb (Antimony), Se (Selneium), Si (Silicon), Sn (Tin), Sr (Strontium), Ti (Titanium), Tl (Thallium), V (Vanadium), Zn (Zinc) **ADD MS to Symbol for ICP/MS**